The American Museum of Natural History



1869
THE LIBRARY

NATURAL HISTORY

AMERICAN MUSEUM OF NATURAL HISTORY, NEW YORK, N.Y.

INDEX TO VOLUME 90, 1981

AUTHORS AND TITLES

A

Alamuddin, N.S., *Marriage—Lebanese Style*, Apr., p. 8
Alcock, J., *Seduction on the Wing*, Dec., p. 36
Alison, R.M., *The Earliest Traces of a Conservation Conscience*, May, p. 72
Allaway, J., *The African Elephant's Drinking Problem*, Apr., p. 30
Archibald, G., *Last Call for the Siberian Crane*, Mar., p. 58
Arnold, R.M., *Weeds That Ride the Rails*, Aug., p. 58
Avise, J.C., *A Matter of Lights and Death*, Sept., p. 6

B

Bancaud, H., *The Acadians of Belle-Ile-en-Mer*, Jan., p. 48
Billings, W.D., *Plants in High Places*, Oct., p. 82
Bitterbaum, E.J., *A Martin House Is Not a Home*, May, p. 64
Boccaccio, A., *Street Urchins of Colombia*, Apr., p. 40
Boltin, L., *British Museum (Natural History)*, Jan., p. 38
Bond, J.M., Jr., *Review*, Oct., p. 118
Brown, C.R., *A Martin House Is Not a Home*, May, p. 64
Brownlee, D.E., *Cosmic Dust*, Apr., p. 73
Bruemmer, F., *Eskimos Are Warm People*, Oct., p. 42
Bryant, J.P., *Hare Trigger*, Nov., p. 46
Byers, J.A., *Peaceable Peccaries*, June, p. 60

C

Campbell, T.C., *More Is Not Necessarily Better*, May, p. 12
Capriotti, E.R., *Seyfert Galaxies*, Feb., p. 82
Carey, C., *Shivering Finches*, Oct., p. 58
Carpenter, G., *The Importance of Mother's Milk*, Aug., p. 6
Cartmill, M., *Review*, Apr., p. 90; Dec., p. 82
Christopher, T.A., *The Seeds of Botany*, Mar., p. 50
Christy, J.W., *Searching for Dim Companions*, June, p. 70
Coffey, M., *In Praise of Plains*, Nov., p. 54
Cook, R.E., *Toxic Tailings and Tolerant Grass*, Mar., p. 28; *Disturbing Plants*, Apr., p. 22; *Plant Parenthood*, July, p. 30; *Pin Cherry Perceptions*, Nov., p. 96
Crawford, R.L., *A Matter of Lights and Death*, Sept., p. 6

D

Delcourt, H.R., *The Virtue of Forests, Virgin and Otherwise*, June, p. 32
del Moral, R., *Life Returns to Mount St. Helens*, May, p. 36
Deyrup, M., *Deadwood Decomposers*, Mar., p. 84

E

Echevarri, J., *Bees for the Birds*, Apr., p. 36
Eldredge, N., *The Elusive Eureka*, Aug., p. 24

F

Felsman, K., *Street Urchins of Colombia*, Apr., p. 40
Foott, J., *Yellowstone Buffalo Winter*, Dec., p. 58
Furst, P.T., *Review*, Jan., p. 92

G

Geist, V., *Neanderthal the Hunter*, Jan., p. 26; *Review*, July, p. 86
Gerlach, L.P., *The Ecology Movement After Ten Years*, Jan., p. 12
Godfrey, L.R., *The Flood of Anti-evolutionism*, June, p. 4
González Grande, J.L., *Spain's Imperial Eagle*, June, p. 40
Gould, S.J., *The Politics of Census*, Jan., p. 20; *Hyena Myths and Realities*, Feb., p. 16; *Kingdoms Without Wheels*, Mar., p. 42; *A Most Chilling Statement*, Apr., p. 14; *The Titular Bishop of Titiopolis*, May, p. 20; *Piltdown in Letters*, June, p. 12; *What, if Anything, Is a Zebra?* July, p. 6; *What Color Is a Zebra?* Aug., p. 16; *Quaggas, Coiled Oysters, and Flimsy Facts*, Sept., p. 16; *Review*, Sept., p. 92; *A Visit to Dayton*, Oct., p. 8; *The Ultimate Parasite*, Nov., p. 7; *Agassiz in the Galâpagos*, Dec., p. 7
Greenough, J.W., *Whales at Table*, Dec., p. 30
Griffiths, N.E.S., *The Acadians of Belle-Ile-en-Mer*, Jan., p. 48
Grobecker, D.B., *Steady as a Rock, Fast as Lightning*, May, p. 50
Grosser, M., *Genesis of the* Gossamer Condor, Mar., p. 64
Grossman, L., *Telltale Inclusions*, Apr., p. 68
Gwaltney, J.L., *Heirs of Disaster*, Mar., p. 12

H

Hansen, J.V.E., *Clothing for Cold Climes*, Oct., p. 90
Harrison, R.E., *Review*, Aug., p. 78
Hendrey, G.R., *Acid Rain and Gray Snow*, Feb., p. 58
Heschong, L., *Thermal Necessity*, Oct., p. 32
High, C., *Indoor Air Pollution*, Oct., p. 110
Huntington, G.E., *Children of the Hutterites*, Feb., p. 34
Hutchins, M., *Olympic Mountain Goats*, Jan., p. 58

I

Ingersoll, A.P., *Saturn's Surprises*, Sept., p. 44

J

Johnson, J., *Leave It to Beaver*, July, p. 44

K

Kastner, J., *Review*, May, p. 88
Kelsall, J.P., *Review*, Nov., p. 110
Kessler, E., *House Warming*, Oct., p. 104
Knutson, R.M., *Flowers That Make Heat While the Sun Shines*, Oct., p. 75
Kugelmass, J.M., *I'd Rather Be a Messenger*, Aug., p. 66

L

Lepp, G.D., *A Least Tern Makes a Right Turn*, Nov., p. 62
Love, M., *With a Little Help from My Friends*, Nov., p. 16

M

Maran, S., *The Solar Shrink*, Jan., p. 82; *A Near Miss*, Mar., p. 98; *A Nonconforming Supernova*, May, p. 78; *Seeing Double and Seeing Triple*, July, p. 24; *Debut of an Interstellar Bubble*, Aug., p. 28; *Getting Ready for Halley*, Nov., p. 32; *Stellar Togetherness*, Dec., p. 24
Marsh, R.L., *Shivering Finches*, Oct., p. 58
Martin, W.K., *Protean Beauty*, Dec., p. 42
Mason, B., *A Lode of Meteorites*, Apr., p. 62
Massey, B.W., *A Least Tern Makes a Right Turn*, Nov., p. 62
Mathewson, M.T., and W., *Early Bird Photographers*, Dec., p. 16
Milliman, J.D., *A Voyage in the East China Sea*, Jan., p. 70
Mitchell, E., *The Whale Behind the Tusk*, Aug., p. 50
Mulcahy, D.L., *Rise of the Angiosperms*, Sept., p. 30

N

Nicholson, T.D., *Celestial Events*, Jan., p. 84; Feb., p. 91; Mar., p. 104; Apr., p. 86; May, p. 70; June, p. 74; July, p. 90; Aug., p. 76; Sept., p. 82; Oct., p. 126; Nov., p. 40; Dec., p. 80
Nietschmann, B., and J., *Good Dugong, Bad Dugong; Bad Turtle, Good Turtle*, May, p. 54
Nylander, J.C., *Come, Gather Round the Chimney*, Oct., p. 98

O

Olano, M., *Bees for the Birds*, Apr., p. 36
Ott, E.A., *Vermont Country Calendar*, Mar., p. 72

P

Perlès, C., *Hearth and Home in the Old Stone Age*, Oct., p. 38
Price, R., and S., *Art of the Rain Forest*, Sept., p. 54

R

Radcliffe, B., *The Ecology Movement After Ten Years*, Jan., p. 12
Raven, P.H., *Tropical Rain Forests: A Global Responsibility*, Feb., p. 28
Reaka, M.L., *The Hole Shrimp Story*, July, p. 36
Reeves, R.R., *The Whale Behind the Tusk*, Aug., p. 50
Reiter, E.R., *The Tibet Connection*, Sept., p. 64
Rensberger, B., *Review*, June, p. 76
Rogers, L., *A Bear in Its Lair*, Oct., p. 64
Rozin, E., and P., *Culinary Themes and Variations*, Feb., p. 6

S

Scheffer, V.B., *Review*, Feb., p. 94
Schildkrout, E., *Young Traders of Northern Nigeria*, June, p. 44
Schoenbaum, S., *Shakespeare—The Poet's Worlds*, June, p. 54
Sheets, P.D., *Volcanoes and the Maya*, Aug., p. 32
Sokolov, R., *The Taming of the Grain*, Jan., p. 98; *Forbidding Fruit*, Feb., p. 102; *Blueberry Blues*, Mar., p. 116; *Chili con Blarney*, Apr., p. 96; *Olympic Trials*, May, p. 92; *The Lime That Failed*, June, p. 88; *A Fish Story*, July, p. 100; *Planter's Lunch*, Aug., p. 88; *Roots*, Sept., p. 98; *Sunbelt Cuisine*, Oct., p. 135; *Cut and Dried*, Nov., p. 116; *Endangered Pisces*, Dec., p. 92
Sordahl, T.A., *Sleight of Wing*, Aug., p. 42
Starin, E.D., *Monkey Moves*, Sept., p. 36
Starr, P.D., *Marriage—Lebanese Style*, Apr., p. 8
Stevens, V., *Olympic Mountain Goats*, Jan., p. 58
Stinchecum, A.M., *Enduring Cold the Japanese Way*, Oct., p. 50
Strickland, D., *The Eskimo vs. the Walrus vs. the Government*, Feb., p. 48
Swanton, H., *Ralph Hoffmann: Unsung Guide to the Birds*, Nov., p. 20
Swinton, W.E., *British Museum (Natural History)*, Jan., p. 38

T

Tattersall, I., *Review*, Mar., p. 92
Turnbull, C., *East African Safari*, May, p. 26; *A Pilgrimage in India*, July, p. 14; *Holy Places and People of India*, Sept., p. 76

V

Vuilleumier, F., *The Origin of High Andean Birds*, July, p. 50

W

Waldheim, K., *On Asian Peoples*, Jan., p. 86
Webbon, B., *Survival in Space*, Dec., p. 50
Weitz, C.A., *Weathering Heights*, Nov., p. 72
West, T.L., *Llama Caravans of the Andes*, Dec., p. 62
Winick, M., *Food and the Fetus*, Jan., p. 76
Wood, J.A., *Long-playing Records*, Apr., p. 56

Z

Zimen, E., *Italian Wolves*, Feb., p. 66

SUBJECT MATTER

Acadians, Canada, Jan., p. 48
Acidification, Feb., p. 58
AFRICA
East, safari, May, p. 26
Elephants, Apr., p. 30
Northern Nigeria, June, p. 44
Red colobus monkeys, Sept., p. 36
Agassiz, Dec., p. 7
ALASKA
Eskimos, Feb., p. 48; Oct., p. 42
Whales, Dec., p. 30
Allende meteorite, Apr., p. 68
Andean highlands, llama caravans, Dec., p. 62
Angiosperms, Sept., p. 30
Anglerfish, May, p. 50
Antarctica and meteorites, Apr., p. 62
ANTHROPOLOGY
Acadians, Jan., p. 48
Andes, llama caravans, Dec., p. 62
City life, New York, Aug., p. 66
Colombia, Apr., p. 40
Druse sect, Apr., p. 8
Eskimos, Feb., p. 48; Oct., p. 42
Hausa society, June, p. 44
Hutterites, Feb., p. 34
Japanese, Oct., p. 50
Maroon tribes, Sept., p. 54
Maya, Aug., p. 32
Mexican village, Mar., p. 12
Neanderthal man, Jan., p. 26
Quechuas, Nov., p. 72
Sherpas, Nov., p. 72
Torres Strait Islanders, May, p. 54
Vermont, Mar., p. 72
Antievolutionism, June, p. 4
Archeology, Maya, August, p. 32; Piltdown man, June, p. 12
ART
Maroon tribes, Suriname, Sept., p. 54
Asteroids, Apr., p. 72
ASTRONOMY
Celestial Events, Jan., p. 84; Feb., p. 91; Mar., p. 104; Apr., p. 86; May, p. 70; June, p. 74; July, p. 90; Aug., p. 76; Sept., p. 82; Oct.,

p. 126; Nov., p. 40; Dec., p. 80
Comet, Halley's, Nov., p. 32
Cosmic dust, Apr., p. 72
Double-star systems, June, p. 70
Galaxies, Feb., p. 82
Meteorites, Apr., p. 52; p. 58; p. 62; p. 68; p. 78
Moon, Apr., p. 58
Nebula, Aug., p. 28
Quasars, July, p. 24
Saturn, Sept., p. 44
Seyfert Galaxies, Feb., p. 82
Sky Reporter, Jan., p. 82; Feb., p. 82; Mar., p. 98; May. p. 78; June, p. 70; July, p. 24; Aug., p. 28; Nov., p. 32; Dec., p. 24
Stars, binary, Dec., p. 24
Sun, Jan., p. 82
Supernova, May, p. 78
AT THE AMERICAN MUSEUM
Asian people, Jan., p. 86
Bark cloth, Nov., p. 104
Exhibition Hall artists, Aug., p. 84
Expeditions, Mar., p. 108
Film festival, Oct., p. 128
Frozen fish, May, p. 84
Hall of Meteorites, Apr., p. 52
Life casts, June, p. 84
Mastodon, Sept., p. 72
Meteorites, Apr., p. 78
Microscopes, Feb., p. 98
Past and future of, July, p. 92
Australia, May, p. 54
Avian migration, Sept., p. 6
Aviation, *Gossamer Condor,* Mar., p. 64
Avocet, American, Aug., p. 42
Baffin Islands, Aug., p. 50
Bears, Oct., p. 64
Beaver, July, p. 44
Bees, Apr., p. 64
Bicycle messengers, New York, Aug., p. 66
Binary stars, Dec., p. 24
BIOLOGY
Fetus, Jan., p. 76
Human milk, Aug., p. 6
BIOS
Grass, species of, Mar., p. 28
Pin cherry, Nov., p. 96
Plants, Mar., p. 28; Apr., p. 22; July, p. 30
BIRDS
American avocet, Aug., p. 42
Andean, July, p. 50
Avian migration, Sept., p. 6
Eagle, June, p. 40
European bee eater, Apr., p. 36
Finches, Oct., p. 58
Guide to, Nov., p. 20
Martins, purple, May, p. 64
Photographers of, Dec., p. 16
Siberian cranes, Mar., p. 58
Stilts, Aug., p. 42
Terns, Nov., p. 62
Bird watching, Nov., p. 20
Blueberries, Mar., p. 116
Botanical garden, Padua, Italy, Mar., p. 50
BOTANY
Douglas fir trees, Mar., p. 84
Forests, June, p. 32
Grass, Mar., p. 28
Herbs, Feb., p. 6
Lime, June, p. 88
Persimmon, Feb., p. 102
Pin cherry, Nov., p. 96
Plants
Alpine, Oct., p. 82
Alterations of, Apr., p. 14
Communities, Apr., p. 22
Flowering, July, p. 30; Sept., p. 30; Oct., p. 75
Research, Mar., p. 50
and Toxins, Nov., p. 46
Weeds, Aug., p. 58
Proteacea, Dec., p. 42
Rain forests, Feb., p. 28; Sept., p. 54
Sassafras trees, Sept., p. 98
British Museum (Natural History), Jan., p. 38
Buffalo, Dec., p. 58
Camels, Mar., p. 42; July, p. 86
CANADA
Acadians, Jan., p. 48
Hutterites, Feb., p. 34
Celestial Events *see* Astronomy
Census, Jan., p. 20
Chili, Apr., p. 96
Chimney, Oct., p. 98
China, coastal occanography, Jan., p. 70
CLIMATE
Changes, Sept., p. 64
Great Plains, Nov., p. 54
Keeping warm, Oct., p. 32; p. 38; p. 42; p. 50; p. 58; p. 64; p. 75; p. 82; p. 90; p. 98; p. 104; p. 110
Mountain altitude, Nov., p. 72
and Neanderthal man, Jan., p. 26
Rain and snow, Feb., p. 58
Colombia, Apr., p. 40
Comets, Apr., p. 72; Nov., p. 32
CONSERVATION
Ancient concept, May, p. 72
Birds, Dec., p. 16
Terns, Nov., p. 62
Cosmic dust, Apr., p. 72
Cranes, Siberian, Mar., p. 58
DNA, Nov., p. 7
Double-star system, June, p. 70
Douglas fir trees, Mar., p. 84
Druse, Apr., p. 8
Eagles, June, p. 40
East China Sea, Jan., p. 70
ECOLOGY
Forest, Mar., p. 84
Toxins, function of, Nov., p. 46
Ecosystem, Mar., p. 84; June, p. 32
Elephants, African, Apr., p. 30
ENDANGERED SPECIES
Siberian cranes, March, p. 58
Spanish imperial eagle, June, p. 40
Terns, Nov., p. 62
ENVIRONMENT
Ecology movement, Jan., p. 12
High altitude, Nov., p. 72
Mount St. Helens, May, p. 36
Vermont, Mar., p. 72
Eskimos, Feb., p. 48; Oct., p. 42
European bee eater, Apr., p. 36
EVOLUTION
Anti-, June, p. 4
Grass, Mar., p. 28
Insect mating systems, Dec., p. 36
Mammals, Mar., p. 42
Fetus, Jan., p. 76
Fibers, natural and synthetic, Oct., p. 90
Finches, Oct., p. 58
Fireplace, Oct., p. 104; and pollution, Oct., p. 110
FISHES
Anglerfish, May, p. 50
Salmon, July, p. 100
Whitefish, Dec., p. 92
Flight, human-powered, Mar., p. 64
FOOD
Blueberries, Mar., p. 116
Chili, Apr., p. 96
and fetus, Jan., p. 76
Herbs, Feb., p. 6
Lime, June, p. 88
Meat, Nov., p. 116
Olympia oyster, May, p. 92
Persimmon, Feb., p. 102
Salmon, July, p. 100
Sassafras, Sept., p. 98
Southern cooking, Aug., p. 88; Oct., p. 135
Whitefish, Dec., p. 92
Wild rice, Jan., p. 98
FOREST
Ecosystem, Mar., p. 84
Rain forest, Feb., p. 28; Sept., p. 54
Fossil, Aug., p. 24; April, p. 90
Franklin stove, Oct., p. 32
FRUIT
Blueberries, Mar., p. 116
Lime, June, p. 88
Persimmon, Feb., p. 102
Galápagos, Dec., p. 7
Galaxies, Seyfert, Feb., p. 82
Genes, Nov., p. 7
Geology, volcanoes, May, p. 36; Aug., p. 32
Goats, mountain, Jan., p. 58
Great Plains, Nov., p. 54
Halley's comet, Nov., p. 32
Hare, snowshoe, Nov., p. 46
Hausa society, June, p. 44
Herbs, Feb., p. 6
HISTORY
of Earth, Apr., p. 58
of science, May, p. 20; Sept., p. 16
Human milk, Aug., p. 6
HUMAN STRATEGY
Druse sect, Apr., p. 8
Mexican village, Mar., p. 12
Hutterites, child rearing, Feb., p. 34
Hyenas, Feb., p. 16
Ichthyology, May, p. 84
India, July, p. 14; Sept., p. 76
INSECTS
Bees, Apr., p. 36
and Douglas fir trees, Mar., p. 84
Wasps, Dec., p. 36
Insulation of houses, Oct., p. 104
INVERTEBRATES
Fossil, Aug., p. 24
Shrimp, July, p. 36
ITALY
Padua, Mar., p. 50
Wolves, Feb., p. 66
Japan, Oct., p. 50
Jerky, Nov., p. 116
KEEPING WARM
Alpine plants, Oct., p. 82
Birds, Oct., p. 58

Eskimos, Oct., p. 42
Fibers, Oct., p. 90
Franklin stove, Oct., p. 32
Indoors and pollution, Oct., p. 110
Insulation, Oct., p. 104
Japanese, Oct., p. 50
Mammals, Oct., p. 64
New England and chimneys, Oct., p. 98
North American Arctic, Oct., p. 42
Plants, Oct., p. 75
and the Stone Age, Oct., p. 38
Lebanon, Druse sect, Apr., p. 8
Lime, June, p. 88
Llama caravans, Dec., p. 62
London, natural history museum, Jan., p. 38
MAMMALS
Bears, Oct., p. 64
Beavers, July, p. 44
Buffaloes, Dec., p. 58
Camels, Mar., p. 42
Dugongs, May, p. 54
Elephants, Apr., p. 30
Goats, Jan., p. 58
Hyenas, Feb., p. 16
Llamas, Dec., p. 62
Monkeys, Sept., p. 36
Peccaries, June, p. 60
Snowshoe hares, Nov., p. 46
Walrus, Feb., p. 48
Whales, Aug., p. 50; Dec., p. 30
Wolves, Feb., p. 66
Zebras, July, p. 6; Aug., p. 16
Mantis shrimp, July, p. 36
Maroon tribes, Sept., p. 54
Martins, purple, May, p. 64
MATTER OF TASTE
Blueberries, Mar., p. 116
Chili, Apr., p. 96
Fish, July, p. 100
Lime, June, p. 88
Meat, jerked, Nov., p. 116
Oysters, May, p. 92
Persimmon, Feb., p. 102
Sassafras, Sept., p. 98
Southern cooking, Aug., p. 88; Oct., p. 135
Whitefish, Dec., p. 92
Wild rice, Jan., p. 98
Maya, Aug., p. 32
Meat, dried, Nov., p. 116
Messengers, Aug., p. 66
Meteorites, Apr., p. 52; p. 56; p. 62; p. 68; p. 78
Meteoroid, Mar., p. 98
MEXICO
Meteorite, Apr., p. 68
Village people, Mar., p. 12
Milk, human, Aug., p. 6
Monkey trial, Oct., p. 8
Monkeys, red colobus, Sept., p. 36
Moon, Apr., p. 58
Mount St. Helens, May, p. 36
Narwhals, Aug., p. 50
NASA, Dec., p. 50
National park, Olympic mountain, Jan., p. 58
NATURALIST AT LARGE
Environment, Nov., p. 16
Fossil, Aug., p. 24
Neanderthal man, Jan., p. 26
Rain forests, Feb., p. 28
Neanderthal man, Jan., p. 26
Nebula, emission, Aug., p. 28
North American Arctic and keeping warm, Oct., p. 42
Nutrition and fetus, Jan., p. 76
Nutritional biochemistry, May, p. 12
Oceanography, Chinese, Jan., p. 70
Oysters, May, p. 92
Padua, botanical garden, Mar., p. 50
Peccaries, collared, June, p. 60
Pediatrics, Jan., p. 76
Persimmon, Feb., p. 102
Photographic competition, winners, July, p. 66
Piltdown man, June, p. 12
Pin cherry, Nov., p. 96
PLANTS
Alpine, Oct., p. 82
Alteration of, Apr., p. 14
Communities, Apr., p. 22
Flowering, July, p. 30; Sept., p. 30; Oct., p. 75
Research, Mar., p. 50
Seeds, Dec., p. 42
and Toxins, Nov., p. 46
Weeds, Aug., p. 58
Politics of census, Jan., p. 20
POLLUTION
and acidification, Feb., p. 58
Indoors, Oct., p. 110
Quasars, July, p. 24
Railroads, Aug., p. 58
Rain forests, Feb., p. 28; Sept., p. 54
Religion, Muslim, June, p. 44
Renaissance literature, June, p. 54
Reptiles, turtles, May, p. 54
Safari, East Africa, May, p. 26
Salmon, July, p. 100
Sassafras, Sept., p. 98
Saturn, Sept., p. 44
Scientific creationism, June, p. 4
Scopes trial, Oct., p. 8
Seed dispersal methods, Dec., p. 42
Seyfert Galaxies, Feb., p. 82
Shakespeare, June, p. 54
Shrimp, July, p. 36
Siberian crane, Mar., p. 58
Sky Reporter *see* Astronomy
Solar collectors, Oct., p. 75
Solar heating, Oct., p. 32
SOUTH AMERICA
Andean birds, July, p. 50
Bolivian llama caravans, Dec., p. 62
Colombia street children, Apr., p. 40
Rain forest, Sept., p. 54
Suriname Maroon tribes, Sept., p. 54
Southern cooking, Aug., p. 88; Oct., p. 135
Spacesuits, Dec., p. 50
Spain, June, p. 40
Spices, Feb., p. 6; Apr., p. 96
Stars, binary, Dec., p. 24
Sun, Jan., p. 82
Supernova Cassiopeia A, May, p. 78
Suriname, art of, Sept., p. 54
Teilhard de Chardin letters, June, p. 12
Terns, Nov., p. 62
Thermal qualities, Oct., p. 32
THIS VIEW OF LIFE
Agassiz, Dec., p. 7
Agricultural science, Apr., p. 14
Census, Jan., p. 20
History of science, May, p. 20; Sept., p. 16; Oct., p. 8
Hyenas, Feb., p. 16
Mammals' feet, Mar., p. 42
Parasite, Nov., p. 7
Piltdown man, June, p. 12
Zebra, July, p. 6; Aug., p. 16
Tibet Plateau, Sept., p. 64
Torres Strait Islanders, May, p. 54
TOURIST AS PILGRIM
East Africa, May, p. 26
India, July, p. 14; Sept., p. 76
Turtles, green sea, May, p. 54
Vermont, rural life, Mar., p. 72
Volcanoes, May, p. 36; Aug., p. 32
Voyager 1 spacecraft, Sept., p. 44
Walrus, Feb., p. 48
Washington State, Jan., p. 58; May, p. 36
Wasps, Dec., p. 36
Weather *see* Climate
WEB OF HUNGER
Fetus, Jan., p. 76
Nutrition, May, p. 12
Weeds, Aug., p. 58
Whale, Aug., p. 50; Dec., p. 30
Whitefish, Dec., p. 92
Wild rice, Jan., p. 98
Wolves, Feb., p. 66
Yellowstone buffalo, Dec., p. 58
Zebras, July, p. 6; Aug., p. 16
BOOKS IN REVIEW
Above Timberline, Feb., p. 94
After Man: A Zoology of the Future, Dec., p. 82
Camel, The, July, p. 86
Caribou and the Barren-Lands, Nov., p. 110
Glass House, The, Oct., p. 118
Lucy: The Beginnings of Humankind, Apr., p. 90
Mapmakers, The, Aug., p. 78
Plants of the Gods, Jan., p. 92
Reckoning With the Beast, May, p. 88
Sand Rivers, June, p. 76
Wondrous Mushroom, The, Jan., p. 92
World Like Our Own, A: Man and Nature in Madagascar, Mar., p. 92
Zoology of the Voyage of H.M.S. Beagle, The, Sept., p. 92

5.06 (747) M1

NATURAL HISTORY

$2



1981

FORD ESCORT BUILT TO TAKE ON THE WORLD... AND DOING IT.





ENGINEERING TEAMS FROM AMERICA AND OVERSEAS JOIN FORCES TO CREATE A NEW CAR WITH BETTER IDEAS FROM AROUND THE WORLD

Top engineers drawn from the worldwide resources of Ford Motor Company teamed up to create Escort. They pooled their expertise...compared, tested, evaluated, experimented—to come up with better ideas.

The result: a high-mileage car built in America to take on the world. Escort will be made in America for American drivers...with other models built and sold overseas.

HIGH MILEAGE THROUGH ADVANCED TECHNOLOGY

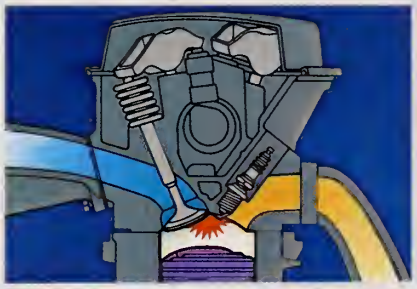
Escort has higher gas mileage ratings than subcompacts such as VW Rabbit, Honda Accord, Toyota Corolla hatchback—yet Escort has more room—in fact, Escort has the room of a compact (based on EPA Volume Index).

30 EPA EST MPG* **44** EST HWY*

*Applicable only to sedans without power steering or A/C. For comparison. Your mileage may differ depending on speed, distance, weather. Actual hwy mileage and Calif. ratings lower. Excludes diesels.

ONE OF THE MOST POWER-EFFICIENT ENGINES AVAILABLE IN AMERICA

Escort's new-design compound valve hemispherical head (CVH)



engine gives you high mileage plus power for freeway driving.

FRONT-WHEEL DRIVE AND FOUR-WHEEL INDEPENDENT SUSPENSION

Escort comes with front-wheel drive...four-wheel fully independent suspension...rack-and-pinion steering...stabilizer bar...new all-season steel-belted radials, and other road-control features.

DRIVE A WORLD CAR

Whether you buy or lease, see your Ford Dealer now to order your Escort...3-door Hatchback, 4-door Liftgate...or even a Squire wagon option. And remember to ask about Ford's Extended Service Plan.



Escort Liftgate...4-doors and wagon room when you need it.

THE NEW WORLD CAR

FORD ESCORT

FORD DIVISION Ford

NATURAL HISTORY

AMERICAN MUSEUM OF NATURAL HISTORY, NEW YORK, N.Y.

INDEX TO VOLUME 90, 1981

AUTHORS AND TITLES

A

Alamuddin, N.S., *Marriage—Lebanese Style*, Apr., p. 8
Alcock, J., *Seduction on the Wing*, Dec., p. 36
Alison, R.M., *The Earliest Traces of a Conservation Conscience*, May, p. 72
Allaway, J., *The African Elephant's Drinking Problem*, Apr., p. 30
Archibald, G., *Last Call for the Siberian Crane*, Mar., p. 58
Arnold, R.M., *Weeds That Ride the Rails*, Aug., p. 58
Avise, J.C., *A Matter of Lights and Death*, Sept., p. 6

B

Bancaud, H., *The Acadians of Belle-Ile-en-Mer*, Jan., p. 48
Billings, W.D., *Plants in High Places*, Oct., p. 82
Bitterbaum, E.J., *A Martin House Is Not a Home*, May, p. 64
Boccaccio, A., *Street Urchins of Colombia*, Apr., p. 40
Boltin, L., *British Museum (Natural History)*, Jan., p. 38
Bond, J.M., Jr., *Review*, Oct., p. 118
Brown, C.R., *A Martin House Is Not a Home*, May, p. 64
Brownlee, D.E., *Cosmic Dust*, Apr., p. 73
Bruemmer, F., *Eskimos Are Warm People*, Oct., p. 42
Bryant, J.P., *Hare Trigger*, Nov., p. 46
Byers, J.A., *Peaceable Peccaries*, June, p. 60

C

Campbell, T.C., *More Is Not Necessarily Better*, May, p. 12
Capriotti, E.R., *Seyfert Galaxies*, Feb., p. 82
Carey, C., *Shivering Finches*, Oct., p. 58
Carpenter, G., *The Importance of Mother's Milk*, Aug., p. 6
Cartmill, M., *Review*, Apr., p. 90; Dec., p. 82
Christopher, T.A., *The Seeds of Botany*, Mar., p. 50
Christy, J.W., *Searching for Dim Companions*, June, p. 70
Coffey, M., *In Praise of Plains*, Nov., p. 54
Cook, R.E., *Toxic Tailings and Tolerant Grass*, Mar., p. 28; *Disturbing Plants*, Apr., p. 22; *Plant Parenthood*, July, p. 30; *Pin Cherry Perceptions*, Nov., p. 96
Crawford, R.L., *A Matter of Lights and Death*, Sept., p. 6

D

Delcourt, H.R., *The Virtue of Forests, Virgin and Otherwise*, June, p. 32
del Moral, R., *Life Returns to Mount St. Helens*, May, p. 36
Deyrup, M., *Deadwood Decomposers*, Mar., p. 84

E

Echevarri, J., *Bees for the Birds*, Apr., p. 36
Eldredge, N., *The Elusive Eureka*, Aug., p. 24

F

Felsman, K., *Street Urchins of Colombia*, Apr., p. 40
Foott, J., *Yellowstone Buffalo Winter*, Dec., p. 58
Furst, P.T., *Review*, Jan., p. 92

G

Geist, V., *Neanderthal the Hunter*, Jan., p. 26; *Review*, July, p. 86
Gerlach, L.P., *The Ecology Movement After Ten Years*, Jan., p. 12
Godfrey, L.R., *The Flood of Anti-evolutionism*, June, p. 4
González Grande, J.L., *Spain's Imperial Eagle*, June, p. 40
Gould, S.J., *The Politics of Census*, Jan., p. 20; *Hyena Myths and Realities*, Feb., p. 16; *Kingdoms Without Wheels*, Mar., p. 42; *A Most Chilling Statement*, Apr., p. 14; *The Titular Bishop of Titiopolis*, May, p. 20; *Piltdown in Letters*, June, p. 12; *What, if Anything, Is a Zebra?* July, p. 6; *What Color Is a Zebra?* Aug., p. 16; *Quaggas, Coiled Oysters, and Flimsy Facts*, Sept., p. 16; *Review*, Sept., p. 92; *A Visit to Dayton*, Oct., p. 8; *The Ultimate Parasite*, Nov., p. 7; *Agassiz in the Galápagos*, Dec., p. 7
Greenough, J.W., *Whales at Table*, Dec., p. 30
Griffiths, N.E.S., *The Acadians of Belle-Ile-en-Mer*, Jan., p. 48
Grobecker, D.B., *Steady as a Rock, Fast as Lightning*, May, p. 50
Grosser, M., *Genesis of the* Gossamer Condor, Mar., p. 64
Grossman, L., *Telltale Inclusions*, Apr., p. 68
Gwaltney, J.L., *Heirs of Disaster*, Mar., p. 12

H

Hansen, J.V.E., *Clothing for Cold Climes*, Oct., p. 90
Harrison, R.E., *Review*, Aug., p. 78
Hendrey, G.R., *Acid Rain and Gray Snow*, Feb., p. 58
Heschong, L., *Thermal Necessity*, Oct., p. 32
High, C., *Indoor Air Pollution*, Oct., p. 110
Huntington, G.E., *Children of the Hutterites*, Feb., p. 34
Hutchins, M., *Olympic Mountain Goats*, Jan., p. 58

I

Ingersoll, A.P., *Saturn's Surprises*, Sept., p. 44

J

Johnson, J., *Leave It to Beaver*, July, p. 44

K

Kastner, J., *Review*, May, p. 88
Kelsall, J.P., *Review*, Nov., p. 110
Kessler, E., *House Warming*, Oct., p. 104
Knutson, R.M., *Flowers That Make Heat While the Sun Shines*, Oct., p. 75
Kugelmass, J.M., *I'd Rather Be a Messenger*, Aug., p. 66

L

Lepp, G.D., *A Least Tern Makes a Right Turn*, Nov., p. 62
Love, M., *With a Little Help from My Friends*, Nov., p. 16

M

Maran, S., *The Solar Shrink*, Jan., p. 82; *A Near Miss*, Mar., p. 98; *A Nonconforming Supernova*, May, p. 78; *Seeing Double and Seeing Triple*, July, p. 24; *Debut of an Interstellar Bubble*, Aug., p. 28; *Getting Ready for Halley*, Nov., p. 32; *Stellar Togetherness*, Dec., p. 24
Marsh, R.L., *Shivering Finches*, Oct., p. 58
Martin, W.K., *Protean Beauty*, Dec., p. 42
Mason, B., *A Lode of Meteorites*, Apr., p. 62
Massey, B.W., *A Least Tern Makes a Right Turn*, Nov., p. 62
Mathewson, M.T., and W., *Early Bird Photographers*, Dec., p. 16
Milliman, J.D., *A Voyage in the East China Sea*, Jan., p. 70
Mitchell, E., *The Whale Behind the Tusk*, Aug., p. 50
Mulcahy, D.L., *Rise of the Angiosperms*, Sept., p. 30

N

Nicholson, T.D., *Celestial Events*, Jan., p. 84; Feb., p. 91; Mar., p. 104; Apr., p. 86; May, p. 70; June, p. 74; July, p. 90; Aug., p. 76; Sept., p. 82; Oct., p. 126; Nov., p. 40; Dec., p. 80
Nietschmann, B., and J., *Good Dugong, Bad Dugong; Bad Turtle, Good Turtle*, May, p. 54
Nylander, J.C., *Come, Gather Round the Chimney*, Oct., p. 98

O

Olano, M., *Bees for the Birds*, Apr., p. 36
Ott, E.A., *Vermont Country Calendar*, Mar., p. 72

P

Perlès, C., *Hearth and Home in the Old Stone Age*, Oct., p. 38
Price, R., and S., *Art of the Rain Forest*, Sept., p. 54

R

Radcliffe, B., *The Ecology Movement After Ten Years*, Jan., p. 12
Raven, P.H., *Tropical Rain Forests: A Global Responsibility*, Feb., p. 28
Reaka, M.L., *The Hole Shrimp Story*, July, p. 36
Reeves, R.R., *The Whale Behind the Tusk*, Aug., p. 50
Reiter, E.R., *The Tibet Connection*, Sept., p. 64
Rensberger, B., *Review*, June, p. 76
Rogers, L., *A Bear in Its Lair*, Oct., p. 64
Rozin, E., and P., *Culinary Themes and Variations*, Feb., p. 6

S

Scheffer, V.B., *Review*, Feb., p. 94
Schildkrout, E., *Young Traders of Northern Nigeria*, June, p. 44
Schoenbaum, S., *Shakespeare—The Poet's Worlds*, June, p. 54
Sheets, P.D., *Volcanoes and the Maya*, Aug., p. 32
Sokolov, R., *The Taming of the Grain*, Jan., p. 98; *Forbidding Fruit*, Feb., p. 102; *Blueberry Blues*, Mar., p. 116; *Chili con Blarney*, Apr., p. 96; *Olympic Trials*, May, p. 92; *The Lime That Failed*, June, p. 88; *A Fish Story*, July, p. 100; *Planter's Lunch*, Aug., p. 88; *Roots*, Sept., p. 98; *Sunbelt Cuisine*, Oct., p. 135; *Cut and Dried*, Nov., p. 116; *Endangered Pisces*, Dec., p. 92
Sordahl, T.A., *Sleight of Wing*, Aug., p. 42
Starin, E.D., *Monkey Moves*, Sept., p. 36
Starr, P.D., *Marriage—Lebanese Style*, Apr., p. 8
Stevens, V., *Olympic Mountain Goats*, Jan., p. 58
Stinchecum, A.M., *Enduring Cold the Japanese Way*, Oct., p. 50
Strickland, D., *The Eskimo vs. the Walrus vs. the Government*, Feb., p. 48
Swanton, H., *Ralph Hoffmann: Unsung Guide to the Birds*, Nov., p. 20
Swinton, W.E., *British Museum (Natural History)*, Jan., p. 38

T

Tattersall, I., *Review*, Mar., p. 92
Turnbull, C., *East African Safari*, May, p. 26; *A Pilgrimage in India*, July, p. 14; *Holy Places and People of India*, Sept., p. 76

V

Vuilleumier, F., *The Origin of High Andean Birds*, July, p. 50

W

Waldheim, K., *On Asian Peoples*, Jan., p. 86
Webbon, B., *Survival in Space*, Dec., p. 50
Weitz, C.A., *Weathering Heights*, Nov., p. 72
West, T.L., *Llama Caravans of the Andes*, Dec., p. 62
Winick, M., *Food and the Fetus*, Jan., p. 76
Wood, J.A., *Long-playing Records*, Apr., p. 56

Z

Zimen, E., *Italian Wolves*, Feb., p. 66

SUBJECT MATTER

Acadians, Canada, Jan., p. 48
Acidification, Feb., p. 58
AFRICA
  East, safari, May, p. 26
  Elephants, Apr., p. 30
  Northern Nigeria, June, p. 44
  Red colobus monkeys, Sept., p. 36
Agassiz, Dec., p. 7
ALASKA
  Eskimos, Feb., p. 48; Oct., p. 42
  Whales, Dec., p. 30
Allende meteorite, Apr., p. 68
Andean highlands, llama caravans, Dec., p. 62
Angiosperms, Sept., p. 30
Anglerfish, May, p. 50
Antarctica and meteorites, Apr., p. 62
ANTHROPOLOGY,
  Acadians, Jan., p. 48
  Andes, llama caravans, Dec., p. 62
  City life, New York, Aug., p. 66
  Colombia, Apr., p. 40
  Druse sect, Apr., p. 8
  Eskimos, Feb., p. 48; Oct., p. 42
  Hausa society, June, p. 44
  Hutterites, Feb., p. 34
  Japanese, Oct., p. 50
  Maroon tribes, Sept., p. 54
  Maya, Aug., p. 32
  Mexican village, Mar., p. 12
  Neanderthal man, Jan., p. 26
  Quechuas, Nov., p. 72
  Sherpas, Nov., p. 72
  Torres Strait Islanders, May, p. 54
  Vermont, Mar., p. 72
Antievolutionism, June, p. 4
Archeology, Maya, August, p. 32; Piltdown man, June, p. 12
ART
  Maroon tribes, Suriname, Sept., p. 54
Asteroids, Apr., p. 72
ASTRONOMY
  Celestial Events, Jan., p. 84; Feb., p. 91; Mar., p. 104; Apr., p. 86; May, p. 70; June, p. 74; July, p. 90; Aug., p. 76; Sept., p. 82; Oct.,

p. 126; Nov., p. 40; Dec., p. 80
Comet, Halley's, Nov., p. 32
Cosmic dust, Apr., p. 72
Double-star systems, June, p. 70
Galaxies, Feb., p. 82
Meteorites, Apr., p. 52; p. 58; p. 62; p. 68; p. 78
Moon, Apr., p. 58
Nebula, Aug., p. 28
Quasars, July, p. 24
Saturn, Sept., p. 44
Seyfert Galaxies, Feb., p. 82
Sky Reporter, Jan., p. 82; Feb., p. 82; Mar., p. 98; May, p. 78; June, p. 70; July, p. 24; Aug., p. 28; Nov., p. 32; Dec., p. 24
Stars, binary, Dec., p. 24
Sun, Jan., p. 82
Supernova, May, p. 78
AT THE AMERICAN MUSEUM
Asian people, Jan., p. 86
Bark cloth, Nov., p. 104
Exhibition Hall artists, Aug., p. 84
Expeditions, Mar., p. 108
Film festival, Oct., p. 128
Frozen fish, May, p. 84
Hall of Meteorites, Apr., p. 52
Life casts, June, p. 84
Mastodon, Sept., p. 72
Meteorites, Apr., p. 78
Microscopes, Feb., p. 98
Past and future of, July, p. 92
Australia, May, p. 54
Avian migration, Sept., p. 6
Aviation, *Gossamer Condor,* Mar., p. 64
Avocet, American, Aug., p. 42
Baffin Islands, Aug., p. 50
Bears, Oct., p. 64
Beaver, July, p. 44
Bees, Apr., p. 64
Bicycle messengers, New York, Aug., p. 66
Binary stars, Dec., p. 24
BIOLOGY
Fetus, Jan., p. 76
Human milk, Aug., p. 6
BIOS
Grass, species of, Mar., p. 28
Pin cherry, Nov., p. 96
Plants, Mar., p. 28; Apr., p. 22; July, p. 30
BIRDS
American avocet, Aug., p. 42
Andean, July, p. 50
Avian migration, Sept., p. 6
Eagle, June, p. 40
European bee eater, Apr., p. 36
Finches, Oct., p. 58
Guide to, Nov., p. 20
Martins, purple, May, p. 64
Photographers of, Dec., p. 16
Siberian cranes, Mar., p. 58
Stilts, Aug., p. 42
Terns, Nov., p. 62
Bird watching, Nov., p. 20
Blueberries, Mar., p. 116
Botanical garden, Padua, Italy, Mar., p. 50
BOTANY
Douglas fir trees, Mar., p. 84
Forests, June, p. 32
Grass, Mar., p. 28
Herbs, Feb., p. 6
Lime, June, p. 88
Persimmon, Feb., p. 102
Pin cherry, Nov., p. 96
Plants
Alpine, Oct., p. 82
Alterations of, Apr., p. 14
Communities, Apr., p. 22
Flowering, July, p. 30; Sept., p. 30; Oct., p. 75
Research, Mar., p. 50
and Toxins, Nov., p. 46
Weeds, Aug., p. 58
Proteacea, Dec., p. 42
Rain forests, Feb., p. 28; Sept., p. 54
Sassafras trees, Sept., p. 98
British Museum (Natural History), Jan., p. 38
Buffalo, Dec., p. 58
Camels, Mar., p. 42; July, p. 86
CANADA
Acadians, Jan., p. 48
Hutterites, Feb., p. 34
Celestial Events *see* Astronomy
Census, Jan., p. 20
Chili, Apr., p. 96
Chimney, Oct., p. 98
China, coastal oceanography, Jan., p. 70
CLIMATE
Changes, Sept., p. 64
Great Plains, Nov., p. 54
Keeping warm, Oct., p. 32; p. 38; p. 42; p. 50; p. 58; p. 64; p. 75; p. 82; p. 90; p. 98; p. 104; p. 110
Mountain altitude, Nov., p. 72
and Neanderthal man, Jan., p. 26
Rain and snow, Feb., p. 58
Colombia, Apr., p. 40
Comets, Apr., p. 72; Nov., p. 32
CONSERVATION
Ancient concept, May, p. 72
Birds, Dec., p. 16
Terns, Nov., p. 62
Cosmic dust, Apr., p. 72
Cranes, Siberian, Mar., p. 58
DNA, Nov., p. 7
Double-star system, June, p. 70
Douglas fir trees, Mar., p. 84
Druse, Apr., p. 8
Eagles, June, p. 40
East China Sea, Jan., p. 70
ECOLOGY
Forest, Mar., p. 84
Toxins, function of, Nov., p. 46
Ecosystem, Mar., p. 84; June, p. 32
Elephants, African, Apr., p. 30
ENDANGERED SPECIES
Siberian cranes, March, p. 58
Spanish imperial eagle, June, p. 40
Terns, Nov., p. 62
ENVIRONMENT
Ecology movement, Jan., p. 12
High altitude, Nov., p. 72
Mount St. Helens, May, p. 36
Vermont, Mar., p. 72
Eskimos, Feb., p. 48; Oct., p. 42
European bee eater, Apr., p. 36
EVOLUTION
Anti-, June, p. 4
Grass, Mar., p. 28
Insect mating systems, Dec., p. 36
Mammals, Mar., p. 42
Fetus, Jan., p. 76
Fibers, natural and synthetic, Oct., p. 90
Finches, Oct., p. 58
Fireplace, Oct., p. 104; and pollution, Oct., p. 110
FISHES
Anglerfish, May, p. 50
Salmon, July, p. 100
Whitefish, Dec., p. 92
Flight, human-powered, Mar., p. 64
FOOD
Blueberries, Mar., p. 116
Chili, Apr., p. 96
and fetus, Jan., p. 76
Herbs, Feb., p. 6
Lime, June, p. 88
Meat, Nov., p. 116
Olympia oyster, May, p. 92
Persimmon, Feb., p. 102
Salmon, July, p. 100
Sassafras, Sept., p. 98
Southern cooking, Aug., p. 88; Oct., p. 135
Whitefish, Dec., p. 92
Wild rice, Jan., p. 98
FOREST
Ecosystem, Mar., p. 84
Rain forest, Feb., p. 28; Sept., p. 54
Fossil, Aug., p. 24; April, p. 90
Franklin stove, Oct., p. 32
FRUIT
Blueberries, Mar., p. 116
Lime, June, p. 88
Persimmon, Feb., p. 102
Galápagos, Dec., p. 7
Galaxies, Seyfert, Feb., p. 82
Genes, Nov., p. 7
Geology, volcanoes, May, p. 36; Aug., p. 32
Goats, mountain, Jan., p. 58
Great Plains, Nov., p. 54
Halley's comet, Nov., p. 32
Hare, snowshoe, Nov., p. 46
Hausa society, June, p. 44
Herbs, Feb., p. 6
HISTORY
of Earth, Apr., p. 58
of science, May, p. 20; Sept., p. 16
Human milk, Aug., p. 6
HUMAN STRATEGY
Druse sect, Apr., p. 8
Mexican village, Mar., p. 12
Hutterites, child rearing, Feb., p. 34
Hyenas, Feb., p. 16
Ichthyology, May, p. 84
India, July, p. 14; Sept., p. 76
INSECTS
Bees, Apr., p. 36
and Douglas fir trees, Mar., p. 84
Wasps, Dec., p. 36
Insulation of houses, Oct., p. 104
INVERTEBRATES
Fossil, Aug., p. 24
Shrimp, July, p. 36
ITALY
Padua, Mar., p. 50
Wolves, Feb., p. 66
Japan, Oct., p. 50
Jerky, Nov., p. 116
KEEPING WARM
Alpine plants, Oct., p. 82
Birds, Oct., p. 58

Eskimos, Oct., p. 42
Fibers, Oct., p. 90
Franklin stove, Oct., p. 32
Indoors and pollution, Oct., p. 110
Insulation, Oct., p. 104
Japanese, Oct., p. 50
Mammals, Oct., p. 64
New England and chimneys, Oct., p. 98
North American Arctic, Oct., p. 42
Plants, Oct., p. 75
and the Stone Age, Oct., p. 38
Lebanon, Druse sect, Apr., p. 8
Lime, June, p. 88
Llama caravans, Dec., p. 62
London, natural history museum, Jan., p. 38
MAMMALS
Bears, Oct., p. 64
Beavers, July, p. 44
Buffaloes, Dec., p. 58
Camels, Mar., p. 42
Dugongs, May, p. 54
Elephants, Apr., p. 30
Goats, Jan., p. 58
Hyenas, Feb., p. 16
Llamas, Dec., p. 62
Monkeys, Sept., p. 36
Peccaries, June, p. 60
Snowshoe hares, Nov., p. 46
Walrus, Feb., p. 48
Whales, Aug., p. 50; Dec., p. 30
Wolves, Feb., p. 66
Zebras, July, p. 6; Aug., p. 16
Mantis shrimp, July, p. 36
Maroon tribes, Sept., p. 54
Martins, purple, May, p. 64
MATTER OF TASTE
Blueberries, Mar., p. 116
Chili, Apr., p. 96
Fish, July, p. 100
Lime, June, p. 88
Meat, jerked, Nov., p. 116
Oysters, May, p. 92
Persimmon, Feb., p. 102
Sassafras, Sept., p. 98
Southern cooking, Aug., p. 88; Oct., p. 135
Whitefish, Dec., p. 92
Wild rice, Jan., p. 98
Maya, Aug., p. 32
Meat, dried, Nov., p. 116
Messengers, Aug., p. 66
Meteorites, Apr., p. 52; p. 56; p. 62; p. 68; p. 78
Meteoroid, Mar., p. 98
MEXICO
Meteorite, Apr., p. 68
Village people, Mar., p. 12
Milk, human, Aug., p. 6
Monkey trial, Oct., p. 8
Monkeys, red colobus, Sept., p. 36
Moon, Apr., p. 58
Mount St. Helens, May, p. 36
Narwhals, Aug., p. 50
NASA, Dec., p. 50
National park, Olympic mountain, Jan., p. 58
NATURALIST AT LARGE
Environment, Nov., p. 16
Fossil, Aug., p. 24
Neanderthal man, Jan., p. 26
Rain forests, Feb., p. 28
Neanderthal man, Jan., p. 26
Nebula, emission, Aug., p. 28
North American Arctic and keeping warm, Oct., p. 42
Nutrition and fetus, Jan., p. 76
Nutritional biochemistry, May, p. 12
Oceanography, Chinese, Jan., p. 70
Oysters, May, p. 92
Padua, botanical garden, Mar., p. 50
Peccaries, collared, June, p. 60
Pediatrics, Jan., p. 76
Persimmon, Feb., p. 102
Photographic competition, winners, July, p. 66
Piltdown man, June, p. 12
Pin cherry, Nov., p. 96
PLANTS
Alpine, Oct., p. 82
Alteration of, Apr., p. 14
Communities, Apr., p. 22
Flowering, July, p. 30; Sept., p. 30; Oct., p. 75
Research, Mar., p. 50
Seeds, Dec., p. 42
and Toxins, Nov., p. 46
Weeds, Aug., p. 58
Politics of census, Jan., p. 20
POLLUTION
and acidification, Feb., p. 58
Indoors, Oct., p. 110
Quasars, July, p. 24
Railroads, Aug., p. 58
Rain forests, Feb., p. 28; Sept., p. 54
Religion, Muslim, June, p. 44
Renaissance literature, June, p. 54
Reptiles, turtles, May, p. 54
Safari, East Africa, May, p. 26
Salmon, July, p. 100
Sassafras, Sept., p. 98
Saturn, Sept., p. 44
Scientific creationism, June, p. 4
Scopes trial, Oct., p. 8
Seed dispersal methods, Dec., p. 42
Seyfert Galaxies, Feb., p. 82
Shakespeare, June, p. 54
Shrimp, July, p. 36
Siberian crane, Mar., p. 58
Sky Reporter *see* Astronomy
Solar collectors, Oct., p. 75
Solar heating, Oct., p. 32
SOUTH AMERICA
Andean birds, July, p. 50
Bolivian llama caravans, Dec., p. 62
Colombia street children, Apr., p. 40
Rain forest, Sept., p. 54
Suriname Maroon tribes, Sept., p. 54
Southern cooking, Aug., p. 88; Oct., p. 135
Spacesuits, Dec., p. 50
Spain, June, p. 40
Spices, Feb., p. 6; Apr., p. 96
Stars, binary, Dec., p. 24
Sun, Jan., p. 82
Supernova Cassiopeia A, May, p. 78
Suriname, art of, Sept., p. 54
Teilhard de Chardin letters, June, p. 12
Terns, Nov., p. 62
Thermal qualities, Oct., p. 32
THIS VIEW OF LIFE
Agassiz, Dec., p. 7
Agricultural science, Apr., p. 14
Census, Jan., p. 20
History of science, May, p. 20; Sept., p. 16; Oct., p. 8
Hyenas, Feb., p. 16
Mammals' feet, Mar., p. 42
Parasite, Nov., p. 7
Piltdown man, June, p. 12
Zebra, July, p. 6; Aug., p. 16
Tibet Plateau, Sept., p. 64
Torres Strait Islanders, May, p. 54
TOURIST AS PILGRIM
East Africa, May, p. 26
India, July, p. 14; Sept., p. 76
Turtles, green sea, May, p. 54
Vermont, rural life, Mar., p. 72
Volcanoes, May, p. 36; Aug., p. 32
Voyager 1 spacecraft, Sept., p. 44
Walrus, Feb., p. 48
Washington State, Jan., p. 58; May, p. 36
Wasps, Dec., p. 36
Weather *see* Climate
WEB OF HUNGER
Fetus, Jan., p. 76
Nutrition, May, p. 12
Weeds, Aug., p. 58
Whale, Aug., p. 50; Dec., p. 30
Whitefish, Dec., p. 92
Wild rice, Jan., p. 98
Wolves, Feb., p. 66
Yellowstone buffalo, Dec., p. 58
Zebras, July, p. 6; Aug., p. 16
BOOKS IN REVIEW
Above Timberline, Feb., p. 94
After Man: A Zoology of the Future, Dec., p. 82
Camel, The, July, p. 86
Caribou and the Barren-Lands, Nov., p. 110
Glass House, The, Oct., p. 118
Lucy: The Beginnings of Humankind, Apr., p. 90
Mapmakers, The, Aug., p. 78
Plants of the Gods, Jan., p. 92
Reckoning With the Beast, May, p. 88
Sand Rivers, June, p. 76
Wondrous Mushroom, The, Jan., p. 92
World Like Our Own, A: Man and Nature in Madagascar, Mar., p. 92
Zoology of the Voyage of H.M.S. Beagle, The, Sept., p. 92

NATURAL HISTORY

Vol. 90, No. 1, January 1981

American Museum of Natural History
Robert G. Goelet, President
Thomas D. Nicholson, Director

6 **Authors**

12 **The Ecology Movement After Ten Years** *Betty Radcliffe and Luther P. Gerlach*
It has shifted from group to individual actions, with energy as a new focus.

20 **This View of Life** *Stephen Jay Gould*
The Politics of Census

26 **A Naturalist at Large** *Valerius Geist*
Neanderthal the Hunter

38 **British Museum (Natural History)** *William E. Swinton, photographs by Lee Boltin*
One of the great institutions in our field celebrates its centenary.

48 **The Acadians of Belle-Ile-en-Mer** *Naomi E.S. Griffiths, photographs by Henri Bancaud*
These eighteenth-century boat people were a thorn in France's royal side.

58 **Olympic Mountain Goats** *Michael Hutchins and Victoria Stephens*
Some of Washington's fragile alpine plants may not survive the introduction of this nimble herbivore.

70 **A Voyage in the East China Sea** *John D. Milliman*
It was the first Sino-American oceanographic project in more than thirty years.

76 **The Web of Hunger** *Myron Winick*
Food and the Fetus

82 **Sky Reporter** *Stephen P. Maran*
The Solar Shrink

84 **Celestial Events** *Thomas D. Nicholson*

86 **At the American Museum**
Kurt Waldheim on Asian Peoples

92 **Books in Review** *Peter T. Furst*
Divine Plants

96 **Additional Reading**

98 **A Matter of Taste** *Raymond Sokolov*
The Taming of the Grain

Cover: *Some descendants of the exiled Acadians still practice traditional farming on Belle-Ile-en-Mer, an island off the coast of France. Photograph by Henri Bancaud. Story on page 48.*

lan Ternes, Editor
udith Friedman, Managing Editor
homas Page, Designer
oard of Editors:
ally Lindsay, Frederick Hartmann,
ittorio Maestro, Rebecca B. Finnell
arol Breslin, Book Reviews Editor
lorence G. Edelstein, Copy Chief
ita Campon, Copy Editor
ngela Soccodato, Art Asst.
ay Zakariasen, Picture Editor
ouglas J. Preston, Publications Editor
usan Rosenberg, Editorial Asst.
illian Berger
ditorial Advisers:
alcolm Arth, James W. Atz,
ark Chartrand, Niles Eldredge,
ee Herman, E. Craig Morris,
orman Newell, Thomas D. Nicholson,
artin Prinz, Gerard Piel,
ina Root, François Vuilleumier

avid D. Ryus, Publisher
radford D. Smith, Business Manager
rederick E. Grossman, Production Mgr.
ark Abraham, Asst. Production Mgr.
rnestine Weindorf, Administrative Asst.
aurie G. Warhol, Advtg. Production Mgr.
ay May Gong

arbara Lynn Gutman, Circulation Mgr.
aniel J. Dynan, Asst. Circulation Mgr.
ob Bruno, Fulfillment Mgr.

ATURAL HISTORY *(ISSN 0028-0712), incorporating ature Magazine, is published monthly by e American Museum of Natural History. entral Park West at 79th Street, New ork, N.Y. 10024. ubscriptions: $15.00 a year. In Canada and all her countries: $18.00 a year. Second-class ostage paid at New York, N.Y. and at dditional offices.*

Copyright © 1980 by merican Museum of Natural History. All rights served. No part of this periodical may be roduced without written consent of Natural istory. *The opinions expressed by authors do t necessarily reflect the policy of the American useum.* Natural History *is indexed in* Reader's uide to Periodical Literature.

dvertising Offices:
atural History Sales
8 Madison Avenue
ew York, N.Y. 10022
esident of Sales, Arthur Hill Diedrick
dvertising Manager, Katherine José

elephone Numbers:
dvertising Sales (212) 826-9467
useum Information (212) 873-4225
ubscription Orders (800) 526-0331 outside N.J.
(800) 932-0834 in N.J.

ange of address notices, undeliverable ies, orders for subscriptions, l other mail items are to be sent to
tural History Membership Services
x 4300
l genfield, New Jersey 07621

The Heritage Club Presents...

Five Ways to Recognize the Outstanding Value of Heritage Club Fine Books

Heirloom editions of the classics at only $12.00 each.



For more than 40 years, book lovers have turned to The Heritage Club because it offers a combination of advantages unmatched by any other classics library...and at an outstanding value.

1 Important Books of Exceptional Beauty and Elegance—Each a Work of Art and a Great Work of Literature.

Throughout the world, Heritage Club books have come to be regarded as definitive editions of the world's greatest classics. The reason is that they are not only masterpieces of literature, but masterpieces of the book crafting art as well.

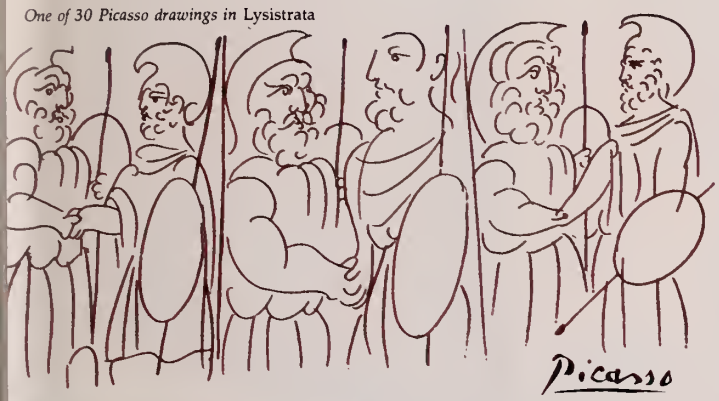
Over the years, The Heritage Club has orchestrated the talents of the world's most renowned artists, typographers, designers, binders and printers to produce books which rank among the finest and most beautiful in the world. Indeed, Heritage books have repeatedly captured top design awards and honors in Europe, Canada and the United States. They have even been exhibited at the Metropolitan Museum of Art.

Every volume evidences this great tradition. The bindings, for example, display a wide variety of colors and rich fabrics. The elegant chapter headings... the hand-set typefaces...even the tone and finish of the paper are selected to suit the meaning and mood of each classic.

When you display such books on your shelves, you will enjoy deep feelings of pride. For these are fine books without compromise. Together, they form a beautiful and harmonious library that lends color, taste and dignity to your home.

2 Original Art Created Exclusively for Heritage Editions by the World's Greatest Artists...Picasso, Rockwell, Grant Wood and others.

One of 30 Picasso drawings in Lysistrata



Norman Rockwell's Tom Sawyer





Sherlock Holmes as seen by Frederic Dorr Steele

To add an enchanting visual dimension to the world's greatest books, The Heritage Club has, over the years, commissioned leading figures in the arts to illustrate each volume. Hence, Heritage editions abound with magnificent original works—many in full color—etchings, wood engravings, drawings, lithographs, and paintings—all designed to increase the pleasure you and your family derive from each book.

It is a sheer delight, for example, while reading the immortal Greek comedy, *Lysistrata*, to see the beautiful young women and courageous warriors of ancient Athens through the eyes of Pablo Picasso. The original works he created expressly for this book now hang in the Museum of Modern Art. Today, the only way you can own these drawings is to possess The Heritage Club edition!

To illustrate *The Adventures of Tom Sawyer* and *Huckleberry Finn*, The Heritage Club, in 1936, commissioned exclusive works by Norman Rockwell. For who better than the warm and witty Rockwell could capture the mischief of Tom and Huck in their meanderings along Twain's beloved Mississippi River. And where else but in The Heritage Club could you find, in one volume, the words of America's most popular author enhanced by the art of America's best loved artist!

And so it goes throughout the collection...Grant Wood's striking paintings for *Main Street* give an extra depth to Sinclair Lewis' memorable characters. The drawings in the Heritage edition of *The Adventures of Sherlock Holmes* were done by Frederic Dorr Steele, the famous illustrator of the original Holmes serialization.



Grant Wood illustration from Main Street

If any publisher, including ourselves, tried to create such a magnificent classics library today, it would be utterly impossible at this price. We can do so only because we long ago acquired the rights to the priceless art of Picasso, Rockwell and others, before the peak of their fame—before the cost of such originals put them beyond the reach of almost all book publishers.

3 Exclusive Introductions by the Twentieth Century's Leading Literary Figures.

A. A. Milne

Sinclair Lewis

Thornton Wilder

Theodore Dreiser

For more than four decades, Heritage has also engaged the leading scholars and critics of our time to write introductions to every Heritage book. Giants of the literary world such as Sinclair Lewis, Thornton Wilder, A.A. Milne, Clifton Fadiman, Theodore Dreiser and others will give you priceless insights into each author's life and times, and the literary treasures a careful reader can unearth if he knows where to look. These masterful essays give you a heightened appreciation of each great book.

(continued on next page)

(continued from previous page)

4 Heritage Club Books are Among the Best Made Books in the World.

Like the classics themselves, Heritage Club books will endure for generations. Compare a Heritage edition to the usual book on your shelf and you will be astonished by the obvious differences.

You will note, for example, the covers are thick and sturdy. They won't curl or warp as do those of ordinary books. The cover fabrics are specially suited to resist moisture and ageing.

The papers are exceptionally heavy and meant to last 100 years without cracking or turning yellow.

In binding, the pages are meticulously thread-sewn. Then, each book is reinforced to afford a double measure of strength and durability.

As a final assurance of excellence and quality, every Heritage book is thoroughly inspected for even the slightest flaw. It must be perfect in every detail before it can be released to a Heritage Club member.

Sturdy lifetime slipcase accompanies each book and protects against sunlight and dust



Elegant readable type faces individually selected for each volume

All originally typeset by hand for sharpest image

Flawless full-color reproductions of original works of art



Heavyweight 88 point cover board resists curling with age

Traditional decorative headband—a hallmark of fine books

Pages thread-sewn for extra strength in binding

Highest-quality, acid-neutral paper won't turn yellow



Covers of colorful, expensive, durable fabrics

5 Heritage Club Books Come with the Many Extra Benefits of Club Membership...All for Only $12 a Book.

Just as Heritage books stand head and shoulders above the ordinary, you will also find that Club Membership is a refreshing alternative to the way other book clubs operate. Here's how:

As a member, you will be spared the petty inconvenience of sending monthly notification each time you don't want a certain selection. Rather, you will receive, upon joining, a Prospectus of the Club's upcoming titles. You can freely choose only those you want to receive, which will then be sent at the rate of one per month. You, of course, may return any book within 30 days for a full refund, and you are at liberty to cancel your membership at any time.

You will also enjoy several delightful "extras"...

You'll receive a bonus book just for joining.

Because of the astonishing quality of our books, the Club would like to place in your hands, free of charge, a superb Heritage edition for your examination. This bonus volume will speak far more persuasively than any magazine announcement can about the beauty and elegance of Heritage books. If for any reason you are not satisfied, simply return it. Your membership will be cancelled and you will owe nothing. If you are delighted with your bonus book, you may then receive other volumes for just $12 each.

A copy of *The Sandglass*, the Club's own book guide, accompanies each edition, providing fascinating background information on the book, author, designer, artist, printer and others who helped make it a distinguished heirloom edition.

The Heritage Club's toll-free phone number lets you have any question or problem about membership handled quickly and personally.

Since nothing is more disappointing than a damaged book, even our packaging is special. Doubly-reinforced shipping cartons, designed for each book, assure that your books will arrive in mint condition.

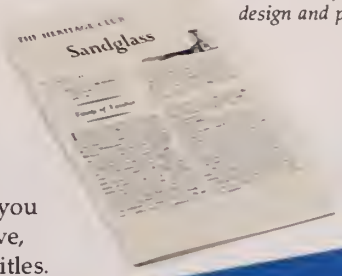
Prompt Action Required

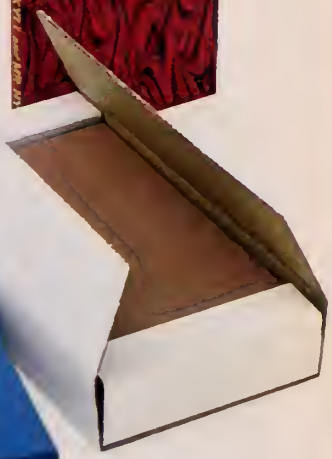
To accept this invitation, you need only complete the Membership Application and return it promptly. Since the Club must plan printings in advance, you must act now if you are to take advantage of this bonus book offer and begin acquiring your own library of the world's greatest books in lasting heirloom editions.

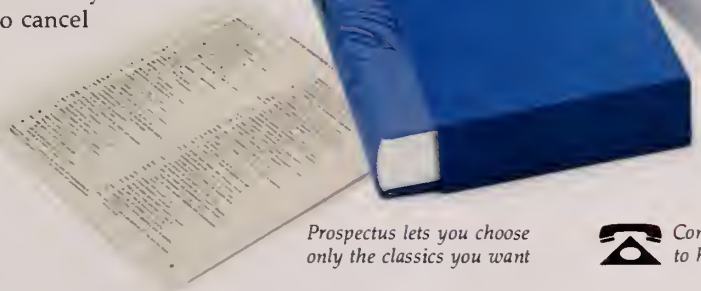
Bonus book just for joining



The Sandglass *guide certifies the "pedigree" of each volume with details of its unique design and production*







Extra heavy packaging assures delivery in perfect condition

Prospectus lets you choose only the classics you want

Convenient toll-free phone number to handle any question or problem

129

Membership Application

THE HERITAGE CLUB
47 Richards Avenue
Norwalk, Conn. 06857

No payment required
Simply mail this application.

YES! I want to join The Heritage Club and begin building my own personal library of the greatest books of all time.

Send me my FREE first volume. Assuming this book is satisfactory, I will then send $12.00 (plus shipping and handling) to pay for the next volume in my Heritage library. I will continue to receive one volume per month in this manner for as long as I continue my membership.

I may cancel my membership at any time. Moreover, I may return any book within 30 days for a full credit or refund. If the first volume does not meet with my approval, I will return it and owe you nothing, and my membership will automatically be cancelled.

Signature _____

Mr.
Mrs.
Miss _____

Address _____

City _____

State _____ Zip _____



Betty Radcliffe's first fieldwork on the study of social movements concerned protest activities against a proposed high-voltage power line in central Minnesota (see "The Great Energy Standoff," *Natural History*, January 1978). By means of interviews with protesters, affected residents, employees of the utilities seeking to build the power line, and public officials involved in selecting a site, Radcliffe "observed at first-hand the development of a major protest movement." This kind of research, she feels, is an "essential preliminary to the formulation of good questionnaires" and prepared her for her work on our 1980 version of "You and the Ecology Movement." A graduate of St. Cloud State University and a former teacher, Radcliffe has worked as Luther Gerlach's research assistant at the University of Minnesota for the past seven years.

Since 1970, when *Natural History* published its first questionnaire on "You and the Ecology Movement," coauthor **Luther P. Gerlach** has been following the development of the environmental movement. Through research, analysis, and interviews, he has also examined the recent growth of other social movements and the controversy over energy. The 1980 version of the ecology questionnaire, which appeared in the June issue of *Natural History*, and the final report in this issue, reflect his interest in how various social movements work to "challenge and change American culture." Gerlach, who received his Ph.D. from the University of London, is professor of anthropology at the University of Minnesota. He is now studying the role of churches in Minnesota in several social issues, chiefly resource development and control.

In 1924, shortly after receiving a Ph.D. in comparative anatomy and vertebrate paleontology from Glasgow University in Scotland, **William E. Swinton** accepted a job at the Natural History Museum in London. He remained there for thirty-seven years, away only during World War II when he served in the British Navy. As a principal scientific officer in the Department of Geology and Paleontology, Swinton helped build up the museum's vertebrate paleontological collections and created the museum's dinosaur galleries. In 1961 he moved to the Royal Ontario Museum in Toronto, where from 1963 to 1966 he served as director. Since 1966, Swinton has been a professor of zoology and the history of science at the University of Toronto. He is currently emeritus professor of the university's Massey College.



THE NIKON FE
A CAMERA TO STIR YOUR EMOTIONS

The automatic Nikon FE is the creative camera par excellence – the embodiment of Nikon sophistication.

Its precise meter system sets correct exposures with uncanny accuracy, automatically. Or, just turn a dial for complete manual control. Either way, the pictures are razor sharp...pure Nikon.

Offering combined capabilities found in no other automatic, it accepts Nikon's extraordinary lenses, accessories and a true 3.5 fps motor drive.

A modern 35mm classic, the Nikon FE is the finest compact automatic in its class. Priced to make it an irresistible value too! Why settle for anything less.

© 1980 Nikon Inc. Garden City, New York 11530



The 1981 Natural History Photographic Competition Is Open

The Grand Prize-winner this year will have a rare opportunity to photograph exotic wildlife with a close-up lens. And the winner may not even be a photographer. Let us explain about the special 1981 contest:

The Grand Prize will be an eleven-day trip, including airfare from New York and a berth on the yacht *Buccaneer*, to the Galápagos Islands. Many fearless creatures on those islands let photographers walk right up to them. The tour, sponsored by the American Museum of Natural History, will be led by two Museum scientists.

Seventeen cash prizes, totaling $3,500, will go to winners in seven categories, including a special new one, Historical Photographs. In this category, you need not be the original photographer, but you do have to own the picture and it should be more than fifty years old. So search your attic and old albums for prize-winning pictures that fit our three major categories.

The three major categories are Animals (including birds and bugs); Plants and Their Environment, and The Human Family. First prizes of $500 will be awarded in each.

In addition, Merit Awards of $250 each will go to the best entries in four categories: Photomicrography; A Sequence in Nature (up to five photographs); Historical Photographs; and Humor in Nature. Ten Honorable Mentions of $100 each will be selected from all entries.

The winning entries will be published in the July issue of *Natural History* and exhibited at the American Museum of Natural History.

THE RULES

1. The competition is open to everyone except employees of the American Museum and their kin.
2. Competitors may submit up to five previously unpublished entries (a sequence is considered a single entry).
3. The Museum acquires the right to publish, exhibit, and use for promotion the winning photographs. The Museum assumes no responsibility for other entries.
4. Entries may be transparencies or prints, either color or black and white, up to 8 by 10 inches. Each must bear the photographer's name and address. Entries must *not* be mounted in glass.
5. Enclose a self-addressed, stamped envelope for the return of entries.
6. Entries must be postmarked no later than April 1, 1981.

Pack them carefully and mail them to:

Natural History Photographic Competition
11 West 77th Street
New York, New York 10024

And good luck!



Born and raised in England, **Naomi E.S. Griffiths** began her studies of the Acadians when she arrived in Canada in 1956 to take a master's degree at the University of New Brunswick. Although she returned to England to earn her Ph.D. in history from London University, her professional career has been linked to Canada and the Acadians. Their resilience, despite a troubled history that includes a mass deportation in 1755, has fascinated Griffiths. She points out that, unlike many other peoples, the Acadians never believed they needed a separate state in order to preserve their identity. At present dean of the Faculty of Arts at Carleton University in Ottawa, Griffiths teaches Acadian and French history.

"My interest in biology developed quite early," writes **Michael Hutchins**. "As a child in rural Iowa I collected insects, amphibians, and reptiles and observed their habits. The crowning glories of these early explorations were the hatching of a luna moth from a cocoon and the raising of a pair of tiger salamanders." Now a doctoral candidate in psychology at the University of Washington, Hutchins's primary research is focused on the evolution of social behavior in birds and mammals. He is continuing his work on the behavioral ecology of mountain goats in Olympic National Park and is applying for a postdoctoral fellowship to study fratricide in the masked booby, a sea bird that nests on oceanic islands.

Also a doctoral candidate at the University of Washington, but in forestry (wildlife biology), coauthor **Victoria Stevens** is concentrating on the population biology of the introduced mountain goat population on the Olympic Peninsula. She has recorded the reproductive history of more than one hundred marked individuals and has done a comparison of the data for nine subpopulations of mountain goats, following their dispersal into new areas and observing their food customs and use of the habitat.



"Most satisfying," says **John D. Milliman** of his work in Chinese waters last summer. "I've long been interested in the big rivers of the world and you can't understand them unless you work in Asia." When that opportunity arose, he therefore jumped at it. An associate scientist at Woods Hole Oceanographic Institution, with degrees in geology and oceanography, Milliman was the U.S. project coordinator on the research voyage described in his article. As a self-confessed foodophile, he also enjoyed the traditional banquets, especially one in Shanghai the night before the cruise began. "It was a fantastic delight," he says. "Eighteen courses. But I must admit, I only got through twelve of them."

Complimentary Catalogue Request

Discover Treasures from Around the World



Send for your complimentary personal copy of the new jewellery, gift and furnishings catalogue from

Willoughby & Taylor Ltd.
International Merchants

Yes! I want to discover treasures from around the world. Please mail me the new Willoughby & Taylor jewellery, gift and furnishings catalogue without cost or obligation.

Block Letters Please: P187

Name

Address Apt. No.

City

State Zip

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL
First Class Permit No. 12696 Chicago, IL

POSTAGE WILL BE PAID BY ADDRESSEE

Willoughby
& Taylor Ltd.
International Merchants

P.O. Box 11077
Chicago, Illinois 60611

The 300,000 Mile Catalogue



From Willoughby & Taylor, Ltd.
International Merchants

300,000 miles. That is approximately how far one would have to travel to find the sources for all the merchandise in the new full-colour Willoughby & Taylor jewellery, gift and furnishings catalogue.

In the tradition of fine old-line trading companies, Willoughby & Taylor, Ltd. virtually travelled the globe in search of the unusual, the unique, the exquisitely beautiful and exotic merchandise seldom seen in the United States. Delicately wrought silver from England, shimmering crystal from Ireland, elegant pewter from a tiny village in Malaysia, jewellery from Spain, priceless pearls from Lake Biwa in Japan...

They have all been delivered to our American vaults and are waiting to be discovered by you.

So send today for your own Willoughby & Taylor American Edition catalogue – and begin an adventure in discovery you won't soon forget.



Meissen of Germany. The oldest and most respected porcelain manufactory in Europe. Who else could have produced such an exquisite sample of porcelain artistry? Hand made and decorated by some of the world's finest living craftsmen, the charming Meissen duck is one of our most treasured discoveries.



The cool precision of the Masters of the Netherlands Renaissance finds expression today in this handcrafted mantelpiece clock from Holland. An ingenious blend of classical balance with rococo nuance of expression, its beauty is matched only by the precision of its timekeeping.



The serene beauty of the Orient is nowhere better demonstrated than in the centuries-old tradition of hand-lacquering. This beautifully made, hand-lacquered, hand-painted hardwood chest, decorated with the ancient symbol of the lotus, was found in a small trading village in Japan.



Since the time of the ancient Egyptians, lapis lazuli has been prized for its rich, azure-blue beauty and, some believed, its medicinal power. This distinctive gentleman's ring features a large, genuine lapis stone in a heavy ridged 14 karat gold mounting for a dramatically important look.

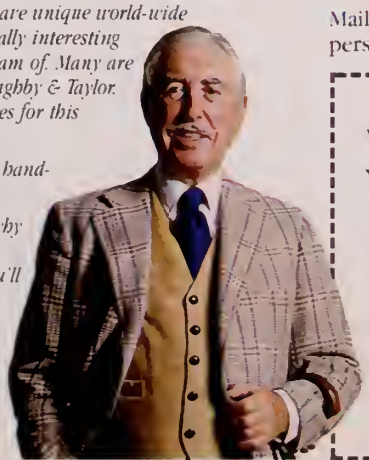
"I want to personally invite you to discover with me some of the rare treasures of the world.

"We at Willoughby & Taylor are privileged to have unique world-wide sources that allow us to locate the kind of really interesting and unusual items other merchants only dream of. Many are exclusive items available only through Willoughby & Taylor. Frankly, I rather think we're outdone ourselves for this American introduction.

"Everything in our catalogue was sought out, hand-picked and shipped over just for you.

"When you see it, I think you'll understand why we're especially proud of the job we're done. And should you decide to place an order, you'll learn why we are equally proud of the exceptional service we provide."

G.H.R. Jackson, Esq.
For Willoughby & Taylor, Ltd.



Willoughby & Taylor Ltd.
International Merchants

Mail attached card or coupon below for your complimentary personal copy of the new Willoughby & Taylor catalogue.

Complimentary Catalogue Request

Willoughby & Taylor, Ltd. · P.O. Box 11077 · Chicago, IL 60611

Yes! I want to discover treasures from around the world. Please mail me the new Willoughby & Taylor catalogue without cost or obligation.

Block Letters Please: P178

Name

Address Apt. No.

City State Zip

The Ecology Movement After Ten Years

The reports of its death are greatly exaggerated

by Betty Radcliffe and Luther P. Gerlach

Is the environmental movement dead or alive? According to the response to *Natural History*'s 1980 "You and the Ecology Movement" questionnaire, published in the July issue, ecological problems continue to be of vital interest to our readers. Comparisons with responses to a similar questionnaire published by *Natural History* in 1970 suggest that the movement is very much alive, although it has taken some new directions, influenced primarily by energy and inflation issues. Such comparisons must be made carefully, however, since only 7 percent of those who responded to the 1980 questionnaire remembered filling out the questionnaire in 1970.

Returns of the 1980 questionnaire came in from all fifty states, several U.S. territories, and several provinces of Canada, as well as from Brazil, Argentina, England, and a number of other countries. We received 3,941 questionnaires in time for coding and processing—three-fourths as many as we received in 1970. This is a remarkable response, considering that in 1970 concern with ecological problems seemed to be growing, while in 1980 many wondered if the environmental movement had been abandoned.

What sort of sample did we analyze and how far can our findings be generalized to the broader public? A profile of our admittedly self-selected sample appears in table 1. In considering the findings of our survey, it is necessary to keep in mind that those who filled in the questionnaire are highly educated and relatively affluent and that the largest percentage of them are in professional, educational, or social service occupations. The sample does not reflect *Natural History*'s entire readership but rather that portion interested enough or, in some cases, angry enough to participate in this survey.

The population sample is broken down into subgroups, according to age, sex, occupation, and levels of education and income. Differences between the various subgroups did appear in the responses to most of our questions, but these were usually differences only of degree, particularly on questions concerning attitudes toward movements in support of environmental protection, social justice, corporate responsibility, and sound energy development and toward more private activities focused on individual change and personal growth. Where significant differences between subgroups did show up, we found that greater percentages of younger people, no more than twenty-nine years old, and women of all ages working in professional, educational, and social service jobs and earning modest incomes tended to take positions that challenged the status quo, favoring both social and personal change. In contrast, men over sixty earning high incomes in engineering or technical occupations tended to have more conservative views. These findings were generally consistent with our 1970 results.

In both 1970 and 1980, many of the questions were designed to explore a broad range of cultural attitudes. The results of the two questionnaires,

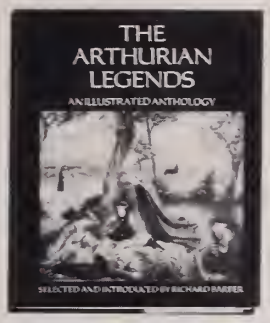
Table 1

Profile of 1980 Sample

Age	**%**
29 or younger	26.9
30 to 59	56.6
60 or older	16.5
Sex	
Male	42.3
Female	57.2
Level of Education	
Less than college degree	24.7
Four-year degree	21.9
Graduate training or advanced degree	53.2
Annual Income	
$14,999 and below	22.5
15,000 to 24,999	26.8
25,000 to 49,999	34.4
50,000 and above	16.0
Occupation	
Professional, Education, or Social Service	39.9
Business	16.4
Government, Military	6.3
Engineering, Technical	8.5
Homemaker, Retired, or Unemployed	11.4

Does anyone out there want to save money on history books?

(First price is publisher's list. **Boldface** shows member's price.)



8656. **The Arthurian Legends: An Illustrated Anthology.** *Selected and introduced by Richard Barber.* Explores the influence of the Arthurian romance as interpreted through the ages. $19.50 / **$13.95**

2162. **Fire and Water: A Life of Peter the Great.** *By Alex de Jonge.* One of the world's most flamboyant rulers—one of history's most extraordinary stories. $12.95 / **$9.50**

8284 **The Devil's Horsemen: The Mongol Invasion of Europe.** *By James Chambers.* $11.95 / **$8.95**

8870. **The Battle For Gaul.** *By Julius Caesar. Translated by Anne and Peter Wiseman.* $15.95 / **$11.50**

8953. **Crispin's Day: The Glory of Agincourt.** *By Rosemary Hawley Jarman.* The vivid medieval drama of Henry V's most famed campaign against the French. $15.00 / **$10.95**

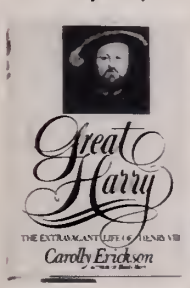
2519 **John D.: The Founding Father of the Rockefellers.** *By David Freeman Hawke.* $12.95 / **$9.95**

7518. **Antietam: The Photographic Legacy of America's Bloodiest Day.** *By William A. Frassanito.* $15.95 / **$10.25**

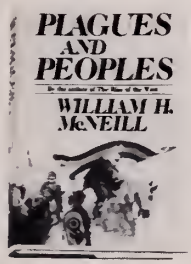
2956. **Germany: 1866-1945.** *By Gordon Craig.* $22.50 / **$14.50**

7765. **Richard the Lionheart.** *By John Gillingham.* Seen from a new perspective, this legendary king emerges as one of the ablest monarchs ever to sit on the British Throne $12.50 / **$8.50**

8250. **Babylon.** *By Joan Oates* $16.95 / **$10.95**



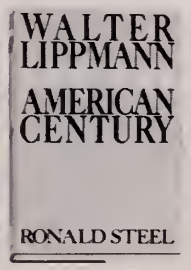
2279. $14.95 / **$10.50**



5207. $10.00 / **$7.75**



2428. $24.00 / **$14.00**



2667. $19.95 / **$13.95**

Consider how much you're spending to read the books you enjoy. Then, consider the alternative.

The History Book Club.

Last year, our members saved an average of 33% off publishers' prices on a variety of books, covering the entire history of man.

And to introduce you to the Club, we have an offer that can save you even more.

Shop this page. We'll send you any three of the books listed here (worth up to $74.00) for just 99¢. Plus a fourth at the low member's price. Just compare our member's prices to the publisher's prices listed below.

You need take only four more books in the next twelve months. After which you'll save even more on bonus books you may choose from our entire list. In your first year, your total savings, including this introductory offer, can be more than 50%.

You can count on getting the best new titles in the same kind of editions you'd find in bookstores. All at savings of $3, $4, $5 (and more), off bookstore prices.

Any three books for 99¢ with trial membership.

Membership Benefits. A membership account will be opened for you, to which your purchases will be charged at the low member's prices. You need pay only after you have received your books. A postage-and-packing fee is added to each shipment.

Every four weeks (13 times a year) you will receive our *Review* containing descriptions of new and recent selections. If you want the Editors' Choice, do nothing; it will be sent automatically. If you want another book, or no book at all, return the card by the date specified. If you should receive an unwanted book because you had less than ten days to decide, you may return it and pay nothing. We guarantee postage.

ND81A

The History Book Club
Stamford, Conn. 06904

Please enroll me as a trial member and send me the four books whose numbers I have entered below. Bill those on the left at 99¢ for all three and the fourth at the low member's price, plus postage-and-packing

I may return the books within three weeks at your expense and owe nothing. Or I will buy four more selections within a year (*not counting my choices above*). Membership is cancellable any time thereafter. All Club purchases are at low member's prices and a postage-and-packing fee is added to all shipments.

NH-52S

Print Name

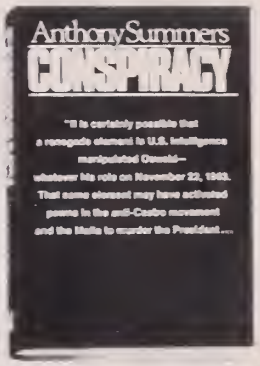
Address Apt. #

City

State Zip

In Canada, mail to The History Book Club, 16 Overlea Blvd., Toronto, M4H 1A6, Ontario

3244 **Alexander the Great.** *By Robin Lane Fox* $15.00 / **$9.95**



2659 **Conspiracy.** *By Anthony Summers.* A chilling report of gripping interest to anyone who remembers November 22, 1963. $17.95 / **$12.50**

8813. **Final Journey: The Fate of the Jews in Nazi Europe.** *By Martin Gilbert.* $12.95 / **$9.50**

1875. **The World of the Huns: Studies in Their History and Culture.** *By Otto Maenchen-Helfen.* $25.00 / **$16.00**

4143. **Russia Under the Old Regime.** *By Richard Pipes.* The first thorough analysis of the growth of the Russian state—from the ninth century to the 1800's. $17.50 / **$10.95**

4648. **The Twelve Caesars.** *By Michael Grant.* $12.50 / **$8.75**

4788 **China's Imperial Past: An Introduction to Chinese History and Culture.** *By Charles O Hucker.* $17.50 / **$11.95**

7849. **The Napoleonic Wars: An Illustrated History, 1792-1815.** *By Michael Glover.* $22.50 / **$12.95**

5462. **The Celts: The People Who Came Out of the Darkness.** *By Gerhard Herm.* $12.50 / **$8.50**

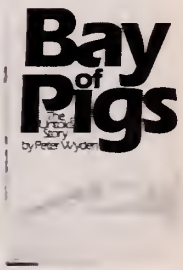
7286. **A Distant Mirror.** *By Barbara Tuchman.* $15.95 / **$9.95**

7583. **The Great Mutiny: India 1857.** *By Christopher Hibbert.* The dramatic story of the bloody uprisings aimed at restoring India's Mogul Past. $15.95 / **$9.95**

7625. **The Hundred Years War: The English in France, 1337-1453.** *By Desmond Seward.* $11.95 / **$8.95**



7401. $17.50 / **$11.50**



8508. $12.95 / **$8.95**



8797. $12.95 / **$9.50**



5504. $25.00 / **$13.00**

You can bring a beautiful animal into your life.

Today.

Lynn Chase, one of America's foremost animal painters, has recently produced two exceptional wild animal portraits in limited editions for discriminating collectors.

One to view.



The Pandas. This beautiful lithograph of three playful Pandas in their natural habitat has been produced in 12 colors on white Arches cover paper, 100% rag, imported from France. The image size is 18" x 35" on a 25½" x 38" sheet. Each print has been hand signed and numbered by Miss Chase in a limited editionof 400.
$150., sent first class mail in a tube.

One to wear.



The Jaguar. As sleek, smooth and beautiful in nature as on this limited edition Italian silk scarf, hand screened in 10 colors. Produced in Como, Italy on a generous 36" square of silk, each scarf has a hand rolled, contrasting hem and is hand signed and numbered by Miss Chase in an edition of 400. The scarf is suitable for framing.
$85., sent first class mail in a box.

Miss Chase's work has been exhibited in major American and European cities and is represented in as many collections here and abroad. Miss Chase has travelled extensively in Africa and is a member of the New York Safari Club, World Wildlife Fund, African Wildlife Leadership Foundation and the New York Zoological Society.

How to order.

To bring one (or both) of these beautiful animals into *your* life, send a check or money order for the edition selected, plus $1.50 for postage and handling, to Lairs Limited, PO Box 453 B Lenox Hill Station, New York 10021. Allow four weeks for delivery. New York State residents add applicable sales tax. You will receive a certificate of authenticity with each purchase.

LairsLimited

compared in table 2, reveal similarities and differences between the two samples, as well as between their respective subgroups. Population control, for example, was more of an issue in 1970 than in 1980. In 1970, the least controversial of all our statements about cultural attitudes was, "I think that all American families, regardless of social or economic position, must limit the number of children to two or, at most, three." There was an interesting pattern in the responses to this question in 1980: Those 60 and over agreed most strongly with the statement; those in the 30 to 59 group, somewhat less strongly; and those 29 and younger, least of all. We also found that the less income people had, the more strongly they agreed with the statement.

On other questions the 1980 sample showed slightly more faith in technology as a way to solve environmental problems and in the adequacy of present laws and conventions governing the use of natural resources on private lands. Those responding to the 1980 questionnaire were also more apt to believe that economic growth is good for any community and less apt to feel that the profit motive is outdated. In general, the 1980 sample believed that environmental problems are connected to economic, technological, and political problems.

Some attitudes have apparently not changed in the last decade. Two statements drew almost exactly the same response on the two questionnaires. Both samples strongly disagreed with the idea that plants and animals exist primarily for human use and enjoyment, and both were fairly evenly divided on whether our ecological problems can be solved by existing American political and economic systems.

The two questionnaires themselves were not exactly the same. In 1980, we included several new questions reflecting the tremendous role energy issues have come to play in the last decade. We knew that many people, including both those whose professions involve them in energy issues and those whose concern is more general, believe that the Western industrial nations' present dependence on imported petroleum is a significant threat to those nations' economic stability. Many who hold this view believe that, at least for the short term, the best solution to this problem is to derive more electricity from nuclear and coal-fired plants and, increasingly, from large, centralized solar energy

Table 2

Cultural Attitudes

		% Agree	% Disagree
Plants and animals exist for our benefit	1970	*	81.0
	1980	15.3	80.5
Technology can solve environmental problems	1970	18.0	*
	1980	25.0	61.3
Private-property owners should be able to use their property according to current laws	1970	*	75.0
	1980	32.9	48.3
The profit motive is outdated and must change	1970	55.0	33.0
	1980	41.7	45.9
Our current political and economic system can solve environmental problems	1970	37.0	45.0
	1980	38.7	46.2
Population growth must be controlled	1970	79.0	*
	1980	63.7	27.4
Economic growth is good for any community	1970	20.0	63.0
	1980	29.6	52.8
Individuals have personal responsibility for pollution	1970	62.0	*
	1980	96.5	2.2

*Data not available

facilities. A massive shift to fossil-based synthetic fuels is often envisioned as part of this scheme. But other people fear that plans such as these and, more generally, the pressure to become energy independent may jeopardize the environmental victories won thus far. It was to investigate these varied views and to gain insight into how people feel energy issues relate to environmental issues that we revised the 1980 questionnaire.

The analysis of the responses to these questions told us, first of all, that the people in our sample think in terms of systems. The many comments we received chiding us for offering simplistic choices or for demanding single solutions to complex problems certainly suggest this interpretation. Asked at what level major problems related to the pollution and degradation of our air, water, and land can best be solved, the majority felt that we should "increasingly manage these problems as parts of complex systems on state, federal, and international levels." Half chose "lack of [a] coherent, effective national energy policy" as our main energy problem.

We also saw in the 1980 sample that there was a strong sentiment for turning to renewable energy resources. Nearly 90 percent of those who responded to the questionnaire were in favor of movements promoting the development of solar technology, if not actually active in such movements (see table 3). In fact, even those who disapproved of most other activist organizations tended to support the solar energy movement. Furthermore, a full three-fourths of the sample agreed with the statement, "I think we are indeed running out of fossil-based fuels."

In general, however, this sentiment did not seem to be linked to a desire to see alternative energy systems supplant more conventional ones. More than half the responses indicated that "integrating conventional fossil-fuel technologies and renewable-energy alternatives in both centralized and decentralized, [and] large and small systems" was the most desirable way to achieve a better, more adaptive energy future. The majority of the people who responded also felt that "improving communication to the public of scientific concepts and technological facts about nuclear and fossil-based fuels" would most effectively resolve current conflicts over energy development.

Go Wild...

And take one of Abercrombie & Kent's exciting safaris in Africa.

NILE CRUISE AND KENYA SAFARI: A deluxe cruise on the Egyptian Nile followed by a safari in Kenya—an incredible combination of Africa's two ultimate travel experiences.

THE LIVINGSTONE SAFARI: A 3 week safari to Tanzania's Serengeti and the Ngorongoro Crater, the beautiful Islands of the Seychelles and then Kenya's famous Treetops and Mount Kenya Safari Club.



SAFARIS ON THE WING: "Wings over Kenya": Mt. Kilimanjaro, Treetops and the Masai Mara, and all the highlights of this jewel of East Africa. "Wings over Africa": Botswana's Okavango and Victoria Falls, two of Southern Africa's most spectacular sights.

We have regular departures every other Friday throughout the year. For further information and brochures contact your travel agent, or

Abercrombie & Kent International, Inc.
Dept. NH2 • 1000 Oak Brook Road
Oak Brook, Illinois 60521
(800) 323-7308 • (312) 887-7766

Abercrombie & Kent . . . simply the best way to travel.

CHICAGO • NEW YORK • LOS ANGELES
LONDON • NAIROBI • JOHANNESBURG • CAIRO

The World's Most Comfortable Shoe!

The Famous CosmoPedic™

Not $50 Not $25
Here Only $14.99



Genuine Leather
Smooth or Sueded

NOW! BLISSFUL COMFORT MORNING TO NIGHT! The closest thing to going barefoot! Handsomely-styled CosmoPedic shoes are the ultimate in comfort . . . and quality-crafted with features you'd expect to find in a $50 or $25 shoe! Luxurious genuine leather uppers in deer-tanned smooth or sueded leather are incredibly soft, yet amazingly shape-holding. The unique CosmoPedic arch support assures comfort thru long hours of standing or walking. A stitched collar prevents annoying chafing around the ankles. And for that walking-on-air feeling . . . cushioned insoles and crepe soles pamper your feet from heel to toe! In Tan or Black smooth leather; Brown or Sand sueded leather . . . just $14.99!

TRY THEM AT OUR RISK!
Return Within 14 Days for Money Back

for Men and Women

Men's ½ sizes: 7 to 12, also 13
Width: C, D, E, EE, EEE
Women's ½ sizes: 5 to 10, also 11
Width: B, C, D, E, EE, EEE

Old Village Shop Hanover, PA 17331

SATISFACTION GUARANTEED OR MONEY BACK

OLD VILLAGE SHOP, Dept. VM-3295 340 Poplar Street, Hanover, PA 17331

Sure, I'll try the world's most comfortable shoes. Please send me:

___prs. Men's Tan Leather (M2425788) Size Width___
___prs. Men's Black Leather (M2368028) Size Width___
___prs. Men's Brown Sueded (M2425868) Size Width___
___prs. Women's Tan Leather (M2035628) Size Width___
___prs. Women's Black Leather (M2036878) Size Width___
___prs. Women's Brown Sueded (M2237848) Size Width___

for just $14.99 pr., plus $2.60 per pr. postage and handling.
SAVE MORE! Order Two pair for just $28.99 plus $4.75 postage and handling.

CHARGE IT: ☐ VISA ☐ Diners' Club ☐ Carte Blanche ☐ American Express ☐ Master Charge
☐ Enclosed is $_____
Acct. #_____ Exp. Date_____
PRINT NAME_____
ADDRESS_____
CITY_____ STATE_____ ZIP_____

We ship within 48 hours; delays notified promptly. Delivery guaranteed within 60 days.

© Old Village Shop 1980

Table 3

Movements in 1980 and Attitudes Toward Them

	For environmental protection	For social justice	Against large-scale, centralized energy development	For solar energy	For corporate responsibility	For individual change
Active in	26.9%	13.6%	9.5%	11.1%	8.2%	12.3%
Favor/not active	43.7	48.1	38.6	76.5	68.8	18.2
Agree with goals, but not all methods	20.2	25.4	16.7	3.8	10.9	18.0
Uncertain	2.2	3.5	7.5	5.6	5.3	27.4
Disapprove of	4.9	7.3	20.4	2.4	4.9	21.0
Disapprove and want suppressed	1.9	2.0	7.3	0.4	1.7	3.0

The responses to the 1980 questionnaire did not tell us how the role of nuclear energy in the future is viewed. More than half of those who responded were "concerned that using nuclear sources for energy may seriously endanger human life on this planet," and one-third selected "nuclear and other hazardous-waste buildup and storage" as "our most critical environmental problem." On the other hand, close to a third disapproved of the category of activist movements that included antinuclear protests. According to many who wrote to us, our coupling of protests against nuclear power with protests against other large-scale, centralized energy-development projects was inappropriate. Some who wrote in told us that they felt greater concern about the more immediate effects of acid rain and the greenhouse effect of burning increased amounts of fossil fuels than they did about the risks of nuclear power.

The various movements to change individuals, either through personal experience, such as meditation, or through interpersonal experiences, such as self-help or sensitivity groups, also drew considerable disapproval. Judging from the comments on returned questionnaires and the letters we received, people generally associated this category with the Eastern religions and such activities as biofeedback groups and transcendental meditation. We had intended the category to include the Christian evangelical "born again" and charismatic movements, but perhaps it is just as well that the people who responded to the questionnaire did not seem to share this interpretation. The explicit coupling of these diverse movements in the same category would have probably elicited the same kind of negative response that our linking of antinuclear protests to protests against other energy projects did.

In general, however (as shown in table 3), the people who responded to the 1980 questionnaire approved of movements and activities undertaken in support of them. We have already indicated the high approval of solar energy movements. The next most favored forms of activism were movements "to make corporations more accountable for actions believed to place at risk the health and welfare of workers and consumers here and in other countries." Interestingly, there was also much support—more than 80 percent—for "boycotting companies that don't seem environmentally or socially responsible." As table 4 shows, next to writing letters, boycotting was the form of activity most frequently engaged in to influence decision makers. Campaigns to hold corporations accountable for their actions have often been associated with church-related organizations, but a majority of those who did not believe that "churches should be actively involved in the critical social and environmental issues of the day" still favored such actions.

According to many who responded to the 1980 questionnaire, the various movements against large-scale energy development and in favor of environmental protection, social justice, corporate responsibility, and personal change are all interrelated. Nearly half saw "some connection between some of them," and almost a fifth

Table 4

Methods of Influencing Decision Makers in 1980

	Action approved	Action taken
Letter writing	94.1%	56.9%
Speaking at public hearings	85.5	24.3
Environmental lawsuits	77.4	7.9
Boycotts	83.1	43.1
Rallies, marches, demonstrations	58.7	20.2
Nonviolent direct action	43.2	4.1
Office sit-ins	15.7	1.0
Destructive or violent action	7.8	.8



ANIMALS SHOWN APPROXIMATELY ACTUAL SIZE



The Woodland Animals

MINIATURE PEWTER SCULPTURES

Twelve beautifully detailed sculptures by the gifted artist Jane Lunger, meticulously crafted in fine pewter, and affordably priced at just $12.50 each.

Available by subscription only, exclusively from The Franklin Mint. Please order by February 10, 1981.

Imagine—for just a moment—that you're standing in a quiet forest glade. It's early morning, and sunlight filters softly through the trees. You brush aside a screen of leaves . . . and there, nestled in the undergrowth, is a baby fawn.

This is part of the magic that inspired Jane Lunger to create a wonderful new collection. *The Woodland Animals Miniature Pewter Sculptures.* Twelve endearing pewter figures—each no more than two inches high—yet each engagingly true to life.

Each miniature a small masterpiece of design and detail

Sculptor Jane Lunger has been acclaimed for her remarkable ability to capture all the spirit and grace of wild animals. For this collection, she has portrayed twelve forest creatures with amazing warmth and realism . . . so that every one of the animals is brought to life in a charmingly original work of art.

Here is the fox, curled up amid clusters of wild violets. He's at rest, but his ears are perked to catch the faintest sound. The beaver munches contentedly on a finely-veined aspen leaf. The fluffy-tailed squirrel seems to be chattering impudently at you from his perch in a tree.

And each original pewter sculpture is richly detailed—so that you can see the most subtle nuances of form and expression . . . and practically *feel* the texture of each animal's fur.

Jane Lunger selected the medium of fine pewter because this metal is unsurpassed in its ability to capture such fine detail. Master pewterers of The Franklin Mint—renowned the world over for their skill—will devote their attention to each work. Every sculpture will be *individually finished* to highlight the lustrous beauty of the pewter itself.

Exceptional quality . . . at a very affordable price

Despite the care and time that must be taken with every sculpture, these original works will be available at the extremely reasonable price of $12.50 each. This price is guaranteed for all subscription applications received by February 10, 1981. *The Woodland Animals* are available exclusively from The Franklin Mint, and only as a complete collection.

Because they so perfectly combine art and nature, these beautifully crafted miniatures will be endlessly fascinating for you, your family, and friends. As a collection, they will be a delight to display in your home.

There is no need to send any money at this time. Please keep in mind, however, that the subscription application should be signed and mailed to The Franklin Mint, Franklin Center, Pennsylvania 19091 by February 10th.

© 1980 FM

At The Franklin Mint, we take pride in our standards of design and craftsmanship. But we believe our efforts should be judged by the people we serve. Any figure may be returned for any reason within thirty days for replacement or refund.

SUBSCRIPTION APPLICATION

The Woodland Animals

MINIATURE PEWTER SCULPTURES

Please postmark by February 10, 1981.

The Franklin Mint
Franklin Center, Pennsylvania 19091

Please enter my subscription for *The Woodland Animals Miniature Pewter Sculptures,* consisting of 12 finely sculptured pewter miniatures by artist Jane Lunger.

I need send no money now. The sculptures will be sent to me at the rate of one every month, and I will be billed $12.50* for each figure, beginning prior to the shipment of the first figure in the series. I may return any figure in the collection within thirty days of receipt for replacement or full refund.

*Plus my state sales tax and $.75 shipping and handling

Signature _____
Mr. _____
Mrs. _____
Ms. _____
PLEASE PRINT EACH

Address _____

City _____

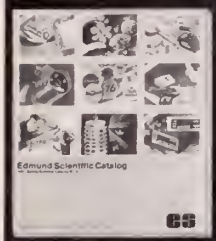
State _____ Zip _____

Limit: One subscription per person.

3

Free!

Edmund Scientific Catalog



OUR 40th YEAR!

Astronomy, Microscopy, Biofeedback, Weather, Alternate Energy, Binoculars, Optics, Magnets, Magnifiers, Tools, Unique Lighting, Lab Equipment, and much more. Over 4,000 unique and fascinating products. Send for our **FREE** 112-page, colorful 1981 Edmund Scientific Catalog...Today!

Rush me your free catalog!

Name

Address

City

State Zip

Clip And Mail Coupon Today To:
Edmund Scientific Co., Dept. 3016 E-02
Edscorp Bldg., Barrington, N.J. 08007

Better Than Jogging



NordicTrack

Jarless Total Body Cardiovascular Exerciser Duplicates X-C Skiing for the Best Motion in Fitness

This revolutionary new exerciser duplicates the smooth, rhythmic, total body motion of X-C skiing for the most effective cardiovascular exercise obtainable. Uniformly exercises more muscles than any other exercise device. Makes high heart rates easy to obtain and keeps more muscles in tone. Also highly effective for weight reduction.

Completely jarless natural motion does not cause joint and back problems as in jogging or running. Arm and leg resistances are separately adjustable for maximum effectiveness. The NordicTrack uses no motors and folds compactly for convenience. Used in homes, businesses, and institutions. Our customers include Xerox Corporation, US Army, Penn State U and the YMCA.

For more info write or call: 612-448-6987
PSI 124 L Columbia ct. Chaska, MN 55318

agreed that the movements were "all aspects of one single wave of revolutionary change." More than half thought "environmental degradation, social injustice, and economic inequality are part of the same basic problem in our society."

The returns of both the 1970 and the 1980 questionnaires indicate that people who believe issues and movements are connected reflect this belief in their actions. Of all the activist movements described in the 1980 forms, the environmental movement claimed the most followers. Of these environmental activists, about one-fourth have overlapping memberships in movements promoting social justice or solar energy, more than a fourth in movements against large-scale energy development plans, and almost a fifth in movements for corporate responsibility.

In both 1970 and 1980 we asked what actions people were taking to express their beliefs about the environment, and the answers to this question revealed a significant difference between the two samples. For example, in 1970, more than 25 percent of those responding to the questionnaire made contact with people involved in environmental organizations three or more times a week. In 1980, only 5 percent had this much contact, and most had no more than a few such encounters each year. In general, activists in the 1970 sample seemed to be part of a young, grass-roots movement, whereas today's activists work within a much more formal, bureaucratic framework and interact with government and industry according to established routine.

Table 5

Life-Style Changes in 1980

Used fewer disposables	67.0%
Recycled garbage	47.5
Modified home to save fossil-based energy	53.8
Changed residence to save energy	20.1
Did not use air-conditioner or recreational vehicle	40.4
Car-pooled or used public transit	43.7
Used smaller car	59.0
Reduced use of motors for recreation	54.9
Visited wilderness areas	36.7
Sought self-sufficient country living	17.6
Changed food habits	2.6
Other conservation of energy activities	8.9
Other preservation of environment activities	2.3
Other	12.1

The 1970 and 1980 questionnaires emphasized not only movements but also change—personal as well as social. And although the 1980 responses revealed less participation in organized environmental activities than the 1970 responses, more than half the people who responded in 1980 indicated that their "involvement with environmental organizations had changed [their] ideas about [themselves] and led [them] to act differently." People active in any one environmental organization tended to be active in several: three-fourths of those who reported membership in groups concerned with environmental problems belonged to two or more, and a third of these belonged to four or more.

Finally, the 1980 sample is characterized by a sense of individual responsibility for environmental problems. More than 95 percent agreed with what was apparently our least controversial question: "I believe I have personal responsibility in the fight against pollution." To get another measure of this level of involvement, we gave examples of personal actions that are commonly believed to contribute to a higher-quality environment and asked our respondents to tell us which of these actions they had taken (see table 5). Not everyone would agree that all these actions are directly related to improving the environment, but because most are either costly or time consuming, we feel they indicate commitment to ecological principles. Close to 60 percent of our sample listed from four to seven of these activities.

In summary, environmental matters are still very important to *Natural History* readers. If our sample is any guide, a decade after Earth Day the environmental movement is most alive on an individual level, with many people choosing to express their ecological concern in their everyday lives. □

Fill out this coupon and save the children

Complete this simple questionnaire, and befriend a needy child through Save the Children. For only fifty-two cents a day, your money, combined with that of other sponsors, can breathe new life into an impoverished village...help hardworking people in their fight for dignity...turn despair into hope for a child who has known only disaster. Fifty-two cents may not buy much where you live. But for the poorest of the poor where the need is so desperate, it can work miracles. NH 1/1

My Name Is _____
(please print)

Address _____

City _____ State _____ Zip _____

Tell us how you want to help, by answering these questions:

1. What kind of child would you like to help?

☐ Boy ☐ Girl ☐ No preference

2. What geographical area are you interested in?

Urgent need exists in all the areas listed below, especially overseas. If you have a strong preference for a particular location, check the area of your choice. If not, won't you please let us assign a child where the need is greatest?

☐ **Certainly. Choose a child for me in an area of greatest need.**

I strongly prefer:

☐ Africa
☐ Bangladesh
☐ Chicano (U.S.)
☐ Colombia
☐ Dominican Republic
☐ Honduras
☐ Indian (U.S.)
☐ Indonesia
☐ Inner Cities (U.S.)
☐ Israel
☐ Korea
☐ Lebanon
☐ Mediterranean
☐ Mexico
☐ Southern States (U.S.)
☐ Sri Lanka (Ceylon)

3. Would you like a picture of your sponsored child?

Shortly after we select a child for you, we can send you a photograph and brief personal history, if you desire.

☐ Yes ☐ No

4. Would you like to exchange correspondence?

If desired, correspondence can build a meaningful one-to-one relationship and provide a unique educational experience for the sponsored child. In areas where illiteracy is high, a village representative will keep you informed of the progress your child is making. Translations, where necessary, are supplied by Save the Children.

☐ Yes ☐ No

5. Would you like information about the child's community?

Several times a year you can receive detailed reports on the activities and projects being undertaken in the community to benefit your sponsored child. These community reports show how your money is being used most effectively for permanent improvements to the child's environment—for health care, education, food production, nutrition, and community training. Would you like to receive such information?

☐ Yes ☐ No

6. How do you wish to send your sponsorship contribution?

Enclosed is my check for $

☐ Monthly, $16 ☐ Semi-annually, $96
☐ Quarterly, $48 ☐ Annually, $192

7. Do you wish verification of Save the Children credentials?

Save the Children is indeed proud of the handling of its funds. Based on last year's audit, an exceptionally large percentage (80.3%) of each dollar spent was used for program services and direct aid to children and their communities. Due to volunteered labor and materials, your donation provides your sponsored child with benefits worth many times your total gift. Would you like to receive an informative Annual Report (including a summary financial statement)?

☐ Yes ☐ No

(A complete audit statement is available upon request.)



8. Would you rather make a contribution than become a sponsor of an individual child at this time?

☐ Yes, enclosed is my contribution of $_____.

☐ Check here for general information about our unique programs for aiding impoverished children.

© 1979 SAVE THE CHILDREN FEDERATION, INC

Mail to:

David L. Guyer, President

Save the Children®

50 Wilton Road, Westport, Connecticut 06880

YOUR SPONSORSHIP PAYMENTS AND CONTRIBUTIONS ARE U.S. INCOME TAX DEDUCTIBLE

Established 1932. The original U.S. child sponsorship agency. Member of the American Council of Voluntary Agencies for Foreign Service.

photo Bentley Kassal

The Politics of Census

Although the latest United States census contains systematic but honest errors, some nineteenth-century counts may have been fraudulent

by Stephen Jay Gould

In the Constitution of the United States, the same passage that prescribes a census every ten years also includes the infamous statement that slaves shall be counted as three-fifths of a person. Ironically, and however different the setting and motives, black people are still being undercounted in the American census. In Detroit, on September 25, 1980, federal judge Horace W. Gilmore invalidated the 1980 census because poor people in inner cities—primarily blacks and Hispanics—had been systematically missed.

The census has always been controversial because it was established as a political device, not as an expensive frill to satisfy curiosity and feed academic mills. The constitutional passage that ordained the census begins: "Representatives and direct taxes shall be apportioned among the several states which may be included within this union, according to their respective numbers."

Political use of the census has often extended beyond the allocation of taxation and representation. The sixth census of 1840 engendered a heated controversy based upon the correct contention that certain black people had, for once, been falsely *over*-counted. This curious tale illustrates the principle that copious numbers do not guarantee objectivity and that even the most careful and rigorous of surveys are only as good as their methods and assumptions. It should also help us to understand why, contrary to common sense, even an honest attempt to count everyone may be one of the worst ways to determine our population. (William Stanton tells this story in *The Leopard's Spots,* his excellent book on the history of scientific attitudes toward race in America during the first half of the nineteenth century. I have also read the original papers of the major protagonist, Edward Jarvis.)

The 1840 census was the first to include counts of the mentally ill and deficient, enumerated by race and by state. Dr. Edward Jarvis, then a young physician but later to become a national authority on medical statistics, rejoiced that the frustrations of inadequate data would soon be overcome. He wrote in 1844:

> The statistics of insanity are becoming more and more an object of interest to philanthropists, to political economists, and to men of science. But all investigations, conducted by individuals or by associations, have been partial, incomplete, and far from satisfactory. . . . They could not tell the numbers of any class or people, among whom they found a definite number of the insane. And therefore, as a ground of comparison of the prevalence of insanity in one country with that of another, or in one class or race of people with that in another, their reports did not answer their intended purpose.

Jarvis then praised the marshals of the 1840 census as apostles of the new, quantitative order:

> As these functionaries were ordered to inquire from house to house, and leave no dwelling—neither mansion nor cabin—neither tent nor ship unvisited and unexamined, it was reasonably supposed that there would be a complete and accurate account of the prevalence of insanity among 17 millions of people. A wider field than this had never been surveyed for this purpose in any part of the earth, since the world began. . . . Never had the philanthropist a better promise of truth hitherto undiscovered. . . . Many proceeded at once to analyze the tables, in order to show the proportion of lunacy in the various states, and among the two races, which constitute our population.

As scholars and ideologues of varying stripes scrutinized the tables, one apparent fact rose to obvious prominence in those troubled times. Among blacks, insanity struck free people in northern states at a vastly greater frequency than it afflicted slaves in the South. In fact, one in 162 blacks was insane in free states, but only one in 1,558 in slave states. But freedom and the North posed no mental terror for whites, since their relative sanity did not differ in the North and South.

Moreover, insanity among blacks seemed to decrease in even gradation from the harsh North to the congenial South. One in 14 of Maine's black population was either insane or idiotic; in New Hampshire, one in 28; in Massachusetts, one in 43; in New Jersey, one in 279. Reaching Delaware, however, the frequency of insanity among blacks suddenly nose-dived. As Stanton writes: "It appeared that Mason and Dixon had suveyed a line not only between Maryland and Pennsylvania but also—surely all unwitting—between Sanity and Bedlam."

In his first publication on the 1840 census, Jarvis drew the same conclusion that so many other whites would advance: slavery, if not the natural state of black people, must have a remarkably beneficent effect upon them. It must exert "a wonderful influence upon the development of moral faculties and the intellectual powers." A slave gains equanimity by "refusing many of the hopes and responsibilities which the free, self-thinking and self-acting enjoy and sustain," for bondage "saves him from some of the liabilities and dangers of active self-direction."

The basic "fact" of ten times more insanity in freedom than in slavery was widely bruited about in the contemporary press, often in lurid fashion. Stanton quotes a contributor to the *Southern Literary Messenger* (1843) who, concluding that blacks grow

Managing Chemical Wastes

What the chemical industry is doing to improve waste-disposal methods

America's chemical companies have already invested hundreds of millions of dollars in safer, better waste-disposal methods. We'll spend over $2 *billion* more on waste-disposal facilities in the next two years. Here's how we're advancing the "state of the art":

1. Eliminating wasteful processes

We're redesigning manufacturing processes and improving efficiency. We're adding on-line treatment systems to neutralize, reduce in volume or change the nature of waste by-products. We're also using recovery techniques that let us recycle wastes back into the production process. One company, for example, is salvaging phenol, used to manufacture plastics, pharmaceuticals and other useful products.

2. Building secure landfills

Secure landfills have a barrier that keeps wastes from seeping out into groundwater and keeps groundwater from migrating through the landfill. Other features may include facilities for recycling liquids or a wastewater treatment unit to clean up liquids for safe disposal. Landfills—if *properly* designed, operated and monitored—are one of the best ways to dispose of many kinds of solid wastes.

3. Continuing industry commitment

We were finding ways to manage solid wastes long before the nation recognized the need for better waste-disposal methods. In fact, we already had much of the required waste-disposal technology and remedial strategies in place—or being developed—when Congress passed the Resource Conservation and Recovery Act of 1976, which sets forth strict waste-disposal guidelines.

4. Sharing knowledge and new technology

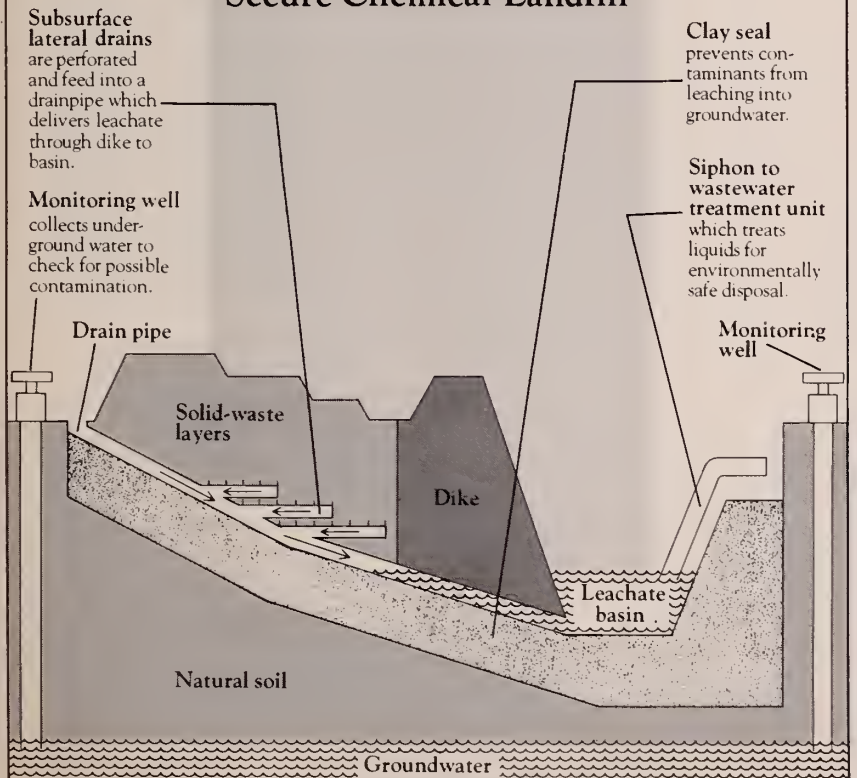
As we develop new waste-disposal techniques, we share our knowledge with industry, government and the public. In 1979, we began conducting a series of regional seminars that presented current techniques for solid-waste disposal. Individual companies may use videotapes, visual aids or other techniques to train personnel in waste-disposal methods.

5. Encouraging solid-waste exchanges

Sometimes one chemical company's wastes can become another company's raw material. Fluoride wastes from a phosphoric acid plant, for example, can be used by a company producing aluminum. So the chemical industry has encouraged the development of waste-exchange organizations, which develop and distribute lists of available wastes.

For a booklet that tells more about what we're doing to protect the environment, write to: Chemical Manufacturers Association, Dept. HL-101, Box 363, Beltsville, MD 20705.

Secure Chemical Landfill



Depending on the solid waste, the chemical industry selects disposal techniques such as incineration, by-product recovery, stabilization or secure landfill design to protect the environment.

America's Chemical Industry

The member companies of the Chemical Manufacturers Association

L.L.Bean®
Outdoor Sporting Specialties



FREE Spring Catalog

Fully illustrated. Features quality apparel and footwear for men, women and children; fishing, hiking, camping and canoeing gear. For 69 years L. L. Bean has offered practical and functional merchandise at reasonable prices. Many items of our own manufacture. All fully guaranteed.

☐ **SEND FREE CATALOG**

Name _____

Address _____

City _____

State_____ Zip_____

L. L. Bean, Inc.
791 Casco St., Freeport, ME 04033



Nature & Cultural Expeditions

Combine adventure, discovery, learning and vacation on expeditions to unique environments worldwide!

In 1981, join NEI in Baja California • Nepal Australia • New Zealand • Ecuador & Peru New Guinea • Galapagos • Sea of Cortez Hawaii • Tanzania & Kilimanjaro • Alaska Peru & Easter Island • Bhutan • Scotland Patagonia & the Falklands • Canyonlands Polynesia • Kashmir & Ladakh • Costa Rica Yucatan & Guatemala • Indian Country Kenya • Japan & Others Worldwide!

Leisurely expeditions for groups of eight to twenty led by experts in natural history or anthropology. Superb photography.

Nature Expeditions International 599 College Ave. • Dept. NG
Palo Alto, CA 94306
(415) 494-6572

"more vicious in a state of freedom," painted a frightful picture of Virginia should it ever become a free state, with "all sympathy on the part of the master to the slave ended." He inquired:

> Where should we find penitentiaries for the thousands of felons? Where, lunatic asylums for the tens of thousands of maniacs? Would it be possible to live in a country where maniacs and felons meet the traveler at every crossroad.

But Jarvis was troubled. The disparity between North and South made sense to him, but its extent was puzzling. Could slavery possibly make such an enormous difference? If the information had not been stamped with a governmental imprimatur, who could have believed it? Jarvis wrote:

> This was so improbable, so contrary to common experience, there was in it such a strong prima facie evidence of error, that nothing but a document, coming forth with all the authority of the national government, and "corrected in the department of state," could have gained for it the least credence among the inhabitants of the free states, where insanity was stated to abound so plentifully.

Jarvis therefore began to examine the tables and was shocked by what he discovered. Somehow, and in a fashion that could scarcely represent a set of random accidents, the number of insane blacks had been absurdly inflated in reported figures for northern states. Jarvis discovered that 25 towns in the 12 free states contained not a single black person of sound mind. The figure for "all blacks" had obviously been recopied or misplaced in the column for "insane blacks." But data for 135 additional towns (including 39 in Ohio and 20 in New York) could not be explained so easily, for these towns actually reported that their population of insane blacks exceeded their total number of blacks, both sane and unhinged!

In a few cases, Jarvis was able to track down the source of error. Worcester, Massachusetts, for example, reported 133 insane in a total black population of 151. Jarvis inquired and discovered that these 133 people were white patients living in the state mental hospital located there. With this single correction, the first among many, black insanity in Massachusetts dropped from one in 43 to one in 129. Jarvis, demoralized and angry, began a decade of unsuccessful campaigning to win an official retraction or correction of the 1840 census. He began:

> Such a document as we have described, heavy with its errors and its misstatements, instead of being a messenger of truth to the world to enlighten its knowledge and guide its opinions, it is, in respect to human ailment, a bearer of falsehood to confuse and mislead.

This debate was destined for a more significant fate than persistent bickering in literary and scholarly journals. For Jarvis's disclosures caught the ear of a formidable man: John Quincy Adams, then near eighty, and capping a distinguished career as leader of antislavery forces in the House of Representatives. But Adams's opponent was equally formidable. At that time, the census fell under the jurisdiction of the Department of State, and its newly appointed secretary was none other than John C. Calhoun, the cleverest and most vigorous defender of slavery in America.

Calhoun, in one of his first acts in office, used the incorrect but official census figures in responding to the expressed hope of the British foreign secretary, Lord Aberdeen, that slavery would not be permitted in the new republic (soon to be state) of Texas. The census proved, Calhoun wrote to Aberdeen, that northern blacks had "invariably sunk into vice and pauperism, accompanied by the bodily and mental afflictions incident thereto," while states that had retained what Calhoun called, in genteel euphemism, "the ancient relation" between races, contained a black population that had "improved greatly in every respect—in number, comfort, intelligence, and morals."

Calhoun then proceeded to evade the official request from the House, passed on Adams's motion, that the secretary of state report on errors in the census and steps that would be taken to correct them. Adams then accosted Calhoun in his office and recorded the secretary's response in his diary:

> He writhed like a trodden rattlesnake on the exposure of his false report to the House that no material errors had been discovered in the printed Census of 1840, and finally said that there were so many errors they balanced one another, and led to the same conclusion as if they were all correct.

Jarvis, meanwhile, had enlisted the support of the Massachusetts Medical Society and the American Statistical Association. Armed with new data and

A POTPOURRI FROM QPB

QPB brings you a great selection of titles from a wide range of fiction and nonfiction. Humor. History. Poetry. Classic and current and of lasting interest.

All are printed on fine paper in readable type. And all are full-size, softcover editions just as durably bound as their hardcover counterparts. Yet they cost up to 65% less. Why pay for the hardcover? Join QPB and pay for the part you read. The inside.



161. The Doctors And Patients Handbook Of Medicines And Drugs. (Second Edition, Revised) Peter Parish, M.D. QPB: $5.95

184. Everyone's Money Book Jane Bryant Quinn Hardcover: $14.95 QPB: $7.95

195. Calligraphic Styles Tom Gourdie, MBE Hardcover: $11.95 QPB: $5.95

343. Skiing The Best. Miles Jaffe and Dennis Kneger. QPB: $4.95



256. American Cookery James Beard. Hardcover: $15.95 QPB: $7.95

275. The Tokyo-Montana Express Richard Brautigan Hardcover: $10.95 QPB Ed: $5.95

281. The Brand New Old House Catalogue. Compiled by Lawrence Grow. Hardcover: $17.95 QPB: $8.50

619. Doonesbury Classics. (4 Vols., Boxed) Garry Trudeau. QPB: $12.95

196. The Painter's Craft: An Introduction to Artists' Methods and Materials. Ralph Mayer Hardcover: $12.95 QPB: $5.95

208. The Number Of The Beast Robert A. Heinlein. QPB: $5.95

209. Portrait Of An Artist A Biography of Georgia O'Keeffe. Laurie Lisle. Hardcover: $14.95 QPB Ed: $6.95

213. Still Life With Woodpecker Tom Robbins. Hardcover: $12.95 QPB: $5.95

111. The Search For Alexander An Exhibition. Contributions by Nicholas Yalouris, Manolis Andronikos, and Katerina Rhomiopoulou. (Photographs) Hardcover: $22.50 QPB: $9.95

118. The Jewish Almanac Richard Siegel & Carl Rheins, Editors. QPB: $7.95

121. Gödel, Escher, Bach: An Eternal Golden Braid. Douglas R. Hofstadter. QPB: $7.50

124. A Field Guide To American Architecture. Carole Rifkind Hardcover: $19.95 QPB: $7.95

143. Memoirs Of Hecate County A novel by Edmund Wilson. Afterword by John Updike QPB: $5.95

151. The Lord Of The Rings J.R.R. Tolkien. (3 Vols., Boxed) Hardcover: $32.95 QPB: $9.95

157. Where Mountains Roar: A Personal Report from the Sinai and Negev Desert. Lesley Hazleton QPB Ed: $6.95

FEATURE



QPB Softcover: $10.95

354. The Next Whole Earth Catalog. Edited by Stewart Brand QPB: $10.95

359. The Living World Of Audubon. Roland C. Clement QPB: $8.50

365. Charlotte Perkins Gilman Reader: "The Yellow Wallpaper" and Other Fiction. Hardcover: $10.95 QPB: $4.95

368. The Techno/Peasant Survival Manual: A Catalog of the Future. Collette Dowling. QPB: $7.95

371. Concise Oxford Dictionary Of Music (Third Edition). Michael Kennedy. Hardcover: $19.95 QPB: $8.95

373. Dream's Edge: Science Fiction Stories About the Future of Planet Earth. Edited by Terry Carr Hardcover: $14.95 QPB: $4.95

374. Second Person Rural: More Essays of a Sometime Farmer. Noel Perrin Hardcover: $10 QPB Ed: $5.95

559. The New York Times Book Of Money. Revised and Updated by Richard E. Blodgett Hardcover: $9.95 QPB: $5.95

341. The Most Of S. J. Perelman S. J. Perelman. QPB: $6.50

Let's try each other for 6 months.

Quality Paperback Book Club, Inc., Middletown, Pa. 17057.
Please enroll me in QPB and send the 3 choices I've listed below. Bill me $3, plus shipping and handling charges. I understand that I am not required to buy another book. You will send me *QPB Review* (if my account is in good standing) for 6 months. If I have not bought and paid for at least 1 book in every six-month period, you may cancel my membership. A shipping and handling charge is added to each shipment. QPB 113-1

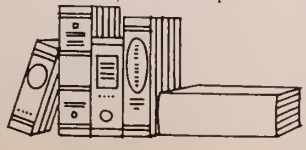
Indicate by number the 3 books or sets you want ☐ ☐ ☐

Name _____ 1-16
(Please print clearly)

Address _____ Apt. _____

City _____ State _____ Zip _____

How membership works.
1. You receive **QPB Review** 15 times each year (about every 3½ weeks). Each issue reviews a *new* Main Selection, plus scores of Alternates. All Main Selections with established publisher's prices are offered at *at least* 20% discount off that price.
2. If you want the **Main Selection** do nothing. It will be shipped to you automatically. If you want one or more Alternate books—or no book at all—indicate your decision on the reply form always enclosed and return it by the date specified.
3. **Bonus books for Bonus Points.** For each book or set you take (except the first 3 you get for $1 each), you earn Bonus Points which entitle you to choose any of the books we offer; you pay only shipping and handling charges.
4. **Return privilege.** If *QPB Review* is delayed and you receive the Main Selection without having had 10 days to notify us, you may return it for credit at our expense.
5. **Cancellations.** You may cancel membership at any time by notifying QPB. We may cancel your membership if you elect not to buy and pay for at least one book in every six-month period.



Join now. Pick any 3 books or sets for $1 each—with no obligation to buy another book.

237. The Homebuyer's Guide For The 80s. Richard W. O'Neill QPB: $6.95

238. A Short History Of The Printed Word. Warren Chappell Hardcover: $12.50 QPB: $7.95

239. A Long Desire and **The White Lantern.** (2 Vols.) Evan S. Connell Hardcover: $22.90 QPB: $8.95

241. The Grey Mane Of Morning Joy Chant. QPB: $6.95

246. The Ambidextrous Universe Mirror Asymmetry and Time-Reversed Worlds. (Second Revised. Updated Edition.) Martin Gardner Hardcover: $12.50 QPB: $3.95

254. A Confederacy Of Dunces John Kennedy Toole Hardcover: $12.95 QPB Ed: $6.95

596. The Solar Age Resource Book Editors of Solar Age Magazine QPB: $7.95

QPB

The first book club for smart people who aren't rich.

NO LOAD'S TOO HEAVY NO CHORE'S TOO TOUGH

for the rugged, amazingly versatile Garden Way Cart!



The Incredible Garden Way Cart!

Yes, handle **HUNDREDS** of tough, time-consuming chores with ease! Our perfectly-balanced, all-purpose Cart lets you wheel BIG, HEAVY loads up to 400 pounds — over rocks, thru mud and even UP hills ... with JUST ONE HAND!
That's not all! From hauling away huge loads of leaves, to wheeling trash cans to the curb, this honest-to-goodness WORKSAVER will serve you day in and out, ALL 4 SEASONS OF THE YEAR!

FREE DETAILS. Mail coupon below and we'll send you complete details about all 3 Garden Way Cart Models and show you — in actual photos — JUST SOME of the amazing things this incredible Cart can do! No obligation, so mail coupon NOW!

GARDEN WAY RESEARCH, Dept A847
Charlotte, Vermont 05445

Garden Way Research
Dept. A847
Charlotte, VT 05445

YES! Please rush me full, illustrated details about the incredible Garden Carts and include info on low-cost Build-it-Yourself Cart Kits!

Name _____
Address _____
City _____
State _____ Zip _____

University of California, Berkeley

RESEARCH EXPEDITIONS PROGRAM



1980-81

- Explore marine environments in the South Pacific
- Study bird behavior off the California coast
- Excavate an 18th C. plantation site in Virginia
- Record Ancient Rock Art on Easter Island
- Study butterfly ecology in Australia
- Observe whale behavior in Baja

Be an active member of a small field research team. Your participation and tax deductible contribution make it possible.

NO PREVIOUS EXPERIENCE NECESSARY

For more information on these and other expeditions, contact:

University Research Expeditions Program
(UREP), Desk NH
University of California
Berkeley, CA 94720 or Phone (415) 642-6586

support, Adams again persuaded the House to ask Calhoun for an official explanation. And again Calhoun wriggled out, finally delivering a report full of obfuscation and rhetoric, and still citing the 1840 figures on insanity as proof that freedom would be "a curse instead of a blessing" for black slaves. Jarvis lived until 1884 and assisted in the censuses of 1850, 1860, and 1870. But he never won official acknowledgment of the errors he had uncovered in the 1840 census; the finagled, if not outrightly fraudulent, data on insanity among blacks continued to be cited as an argument for slavery as the Civil War approached.

There is a world of difference between the overcount of insane blacks in 1840 and the undercount of poor blacks (and other groups) in central cities in 1980. First, although the source of error in the 1840 census has never been determined, we may strongly suspect some systematic, perhaps conscious manipulation by those charged with putting the raw data in tabular form. I think we can be reasonably confident that, with automated procedures and more deliberate care, the systematic errors of the 1980 census are at least honest ones. Second, the politics of 1840 left few channels open to critics, and Calhoun's evasive stubbornness finally prevailed. Today, nearly every census is subjected to legal scrutiny and challenge. Indeed, a few days after Judge Gilmore ruled the 1980 census invalid until its errors can be corrected, Judge Henry F. Werker of Manhattan held that the Census Bureau may use statistical adjustments (rather than actual recounts) to rectify its figures.

But a strong similarity also connects 140 years. The prestige of the census, invoked with such skill by Calhoun to divert his critics, still prevents the reform that might curtail its persistent and systematic errors. This prestige arises from the mystique of quantification, the idea that numerical form renders information more rigorous, if not unassailable. But numbers are only as good as the procedures used to gather them; if methods are flawed, sheer accumulation advances us not one whit further toward accuracy. Second, the peculiar form of quantification used by the census gives it an air of invincibility. For the American census is not a statistical operation at all. It does not attempt to infer properties of the whole from samples. It actually tries to count the whole by direct, exhaustive enumeration. At first glance, what could be fairer and less subject to systematic error? Surely, a procedure of inference from samples offers more opportunity for bias.

If it were possible (however expensive) to count the whole with confidence, then no valid complaint could be raised. But it is not, and the very attempt to do so engenders a systematic error that guarantees failure. For some people are much harder to find than others, either by their direct resistance to being counted (illegal aliens, for example) or by the complex of unfortunate circumstances that renders the poor more anonymous than other Americans.

Regions with a concentration of poor people will be systematically undercounted, and such regions are not spread across America at random. They are located in the heart of our major cities. A census that assesses population by direct counting will be a source of endless contention so long as federal money and representation in Congress reach cities as rewards for greater numbers.

Ironically, the common-sense idea of simply counting everybody is probably the worst, and certainly the most expensive, way to conduct a census. Schemes of careful sampling and inference—a perfected version of the methods used to compile television-rating statistics, for example—would do a better job. At least they would attempt to deal explicitly with recognized biases and might reduce or eliminate systematic errors that arise from the flawed design of trying to count everyone when it cannot be done.

Censusing has always been contentious, especially since its historical purpose has usually involved taxation or conscription. When David, inveigled by Satan himself, had the chutzpah to "number" Israel (I Chronicles, chapter 21), the Lord punished him by offering some unpleasant alternatives: three years of famine, three months of devastation by enemy armies, or three days of pestilence (all reducing the population, perhaps to countable levels). The legacy of each American census will be ten years of contention, at least until we realize that counting noses is not the best way to enumerate vast numbers of varied people.

Stephen Jay Gould teaches biology, geology, and the history of science at Harvard University.

Get the Lion's share!

High Yields. Plus

Daily dividends!
Daily compounding!
Daily liquidity!

You get all this when you invest in Dreyfus Liquid Assets, the high yielding money market fund:

Dividends are declared and compounded daily. You get free checks for cash as you need it, or to pay larger bills. And you keep on earning today's high money market yields until your redemption check clears.

There is no sales charge, there's no penalty for early withdrawals--you can even redeem your investment by phone. Start with just $2,500. Additions can be as low as $100.

Learn how you can get the Lion's share of today's money market rates. Send coupon or call today.

Dreyfus Liquid Assets---

For more complete information, including management fee charges and expenses, obtain a prospectus by sending this coupon. Read it carefully before you invest or send money.

Name _____

Address _____

City _____

State _____ Zip _____

2260105

Post Office Box 600
Middlesex, NJ 08846

FOR A PROSPECTUS

Call toll free, day or night, 7 days a week

1-800-345-8501
Extension 401

In Pennsylvania
1-800-662-5180
Extension 401

0381

Neanderthal the Hunter

He was a superpredator. He was stunningly strong. He killed mammoths and woolly rhinos at close quarters. But he was finished when the climate turned warm

by Valerius Geist

When examining the fossils of some long-extinct creature, paleontologists accept the proposition that its manner of living and the food it ate are expressed in the shapes and dimensions of its bones. If the fossilized cheek teeth of an herbivorous mammal, for example, are long, open rooted, and wide, the animal lived on abrasive forage. If the body size of the animal is small, we can safely assume that the forage consumed was highly digestible. Therefore, the abrasiveness of the forage could not be due to a high fiber content, but must result from sand and dust particles adhering to the exterior of the plant material. Also, most modern small-bodied ungulates occur in warm regions. It follows then that the extinct ungulate in question occupied a habitat that was most likely a warm, dusty, windswept, sparsely vegetated steppe.

To test this proposition, the skull and postcranial skeleton should be examined. Are the eye orbits large? Is the skeleton that of a cursorial form? Are the tarsals and carpals fused into long, slender bones and the lateral digits greatly reduced to facilitate fast running over hard ground? The weapon system and the relative size of the sexes are other anatomical clues useful in determining the type of animal involved. If the hornlike organs are as complex as those used in wrestling and pushing matches by most contemporary deer and antelopes, we are likely dealing with a highly gregarious animal. The same conclusion can be reached if the weapons are greatly reduced or absent. Weapons that are used only to damage body surfaces, and thereby maximize pain, are incompatible with gregariousness. If the differences in body size between sexes are also negligible, we can be quite certain that the sexes lived together year-round in large herds.

Each conclusion is based on parallels with living forms, while the validity of the reconstruction is derived in good measure from the fact that each adaptation fits logically into a pattern. Such a pattern is called a strategy, or more precisely, an adaptive strategy. A strategy is composed of tactical components that must fit flawlessly with one another. The more components and the more complex their mutually supporting web, the more likely is the envisioned adaptive strategy. Microfossils and pollen found in association with the bones can further test the reconstruction.

I would like to use the same procedure to reconstruct the basic adaptive strategy of one of the most enigmatic humans from the past—Neanderthal. To do this, I shall attempt to link into one logical pattern the anatomical peculiarities of Neanderthal people, the characteristics of their tools, their large hearths filled with bone ash, their kill patterns of large mammals, and their precipitous disappearance. The information painstakingly assembled by archeologists will be useful, but an understanding of the peculiar periglacial landscapes Neanderthals inhabited and of the biology of large, dangerous mammals—their chief food—is crucial.

Periglacial landscapes, land greatly affected by the edges of continental and cordilleran glaciers, were often characterized by a mosaic of productive habitats with cold climate floras. The major habitats were fertile, dusty, loess steppes and rich grasslands on moist sites. These owed their existence to huge amounts of rock flour ground by the ice masses and spewed out with meltwater. This highly fertile ground-up rock was deposited as silt by meltwaters from the glaciers, and wherever it was desiccated by exposure to sun and air, it was carried away as loess by the strong winds coming from the ice masses. The annual pulses of ground rock and water created what is technically called a pulse-stabilized, immature ecosystem. This ecosystem, with its different habitats, was host to a highly diverse, dense megafauna of large grazers and large carnivores. It is no accident that in colonizing cold landscapes, humans inhabited the rich periglacial landscapes first and the unproductive tundra (a major interglacial habitat) tens of thousands of years later, in fact only within historic times. Nor is it an accident that the major breadbaskets of today are

24 Impressionist Masterpieces

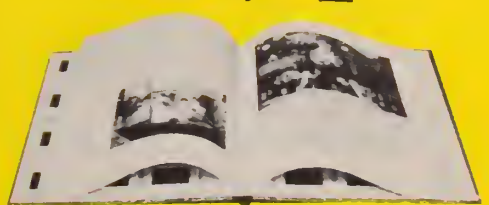
ON 35mm. COLOR SLIDES for only $1

Please enter my trial subscription and send me the complete *Color Slide Album of Impressionist Painting*, including 24 color slides and 48-page illustrated art book. Bill me only $1, plus a few cents for tax and shipping. If I am not delighted with this introductory package, I may return everything within 15 days, cancel my subscription, and owe nothing.

If I do continue, you will send me a new Color Slide Album approximately every six weeks (for 15 days trial examination) and bill me at the subscribers' low price of $12.95, plus tax and shipping. I may take as few or as many Albums as I like, and may stop whenever I wish. After my fourth shipment I will be given a choice of receiving all remaining Albums at once, or continuing with single-album shipments.

☐ Check here if you wish the Kodak Carousel BC 604 Projector, and remit low subscribers price of only $99.50 plus tax with this card in envelope addressed to McGraw-Hill Color Slide Program of Art Enjoyment. If not delighted, return projector within 15 days for full refund

This offer applies to U.S. only



▲ *Included—at no extra cost—this Deluxe Album and 48-page Gallery Lecture Guide*

Name_____

Address_____

City_____

State_____ Zip_____

McGraw-Hill Color Slide Program of Art Enjoyment
Dept. AY-148, 1221 Avenue of the Americas
New York, N.Y. 10020

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD

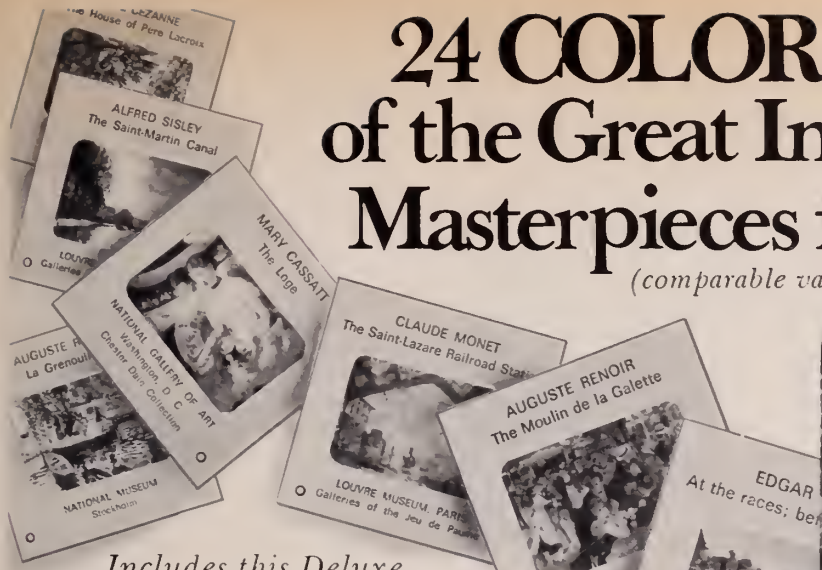
FIRST CLASS PERMIT NO. 26 NEW YORK, N.Y.

POSTAGE WILL BE PAID BY ADDRESSEE

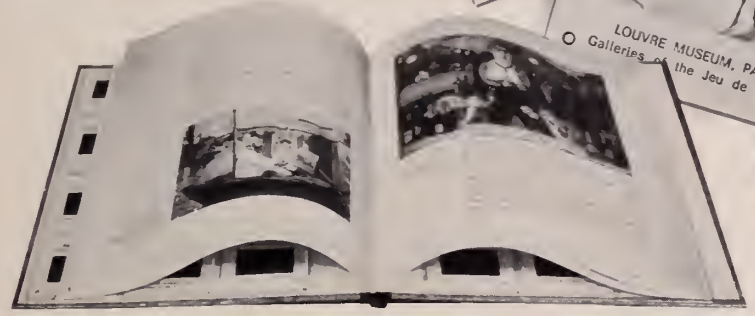
McGraw-Hill
Color Slide Program
of Art Enjoyment
1221 Avenue of the Americas
New York, N.Y. 10020

24 COLOR SLIDES of the Great Impressionist Masterpieces for only $1

(comparable value $18 to $24)



Includes this Deluxe Album and 48-page Gallery Lecture Guide—at no extra cost





Here's what you get for only $1

Luncheon on the Grass—Edouard Manet
Women in the Garden—Claude Monet
The Green Parasol—Berthe Morisot
Nude in the Sun—Auguste Renoir
The Seated Bather—Auguste Renoir
The Pedicure—Edgar Degas
The Saint-Lazare Railroad Station—Claude Monet
The House of Pere Lacroix—Paul Cezanne
The Saint-Martin Canal—Alfred Sisley
At the Races—Edgar Degas
The Red Roofs—Camille Pissarro
The Loge—Mary Cassatt
. . . plus 12 other Impressionist classics!



The Color Slide Program of Art Enjoyment

GAZE in astonishment as Renoir's lovely "Seated Bather" (shown above) appears on your wall aglow with all the vibrant reds, blues and greens of the Impressionist palette. Or, thrill to Rembrandt's famed "Aristotle Contemplating the Bust of Homer"—one of the world's costliest works of art. Or, marvel as you view Titian's allegorical masterpiece "Sacred and Profane Love" just as it appears in Rome's Borghese Gallery.

Until today, unless you had the means to travel among the world's great museums and private collections, you simply could not know these paintings so *intimately*. Now, as a member of the *McGraw-Hill Color Slide Program of Art Enjoyment*, they are but a few of the magnificent art works you will enjoy and more richly understand as you view them in dramatic *full-size* and glowing *original colors!*

Accept this $1 demonstration offer

If you mail the attached card, you will receive a unique Album containing 24 color slides of priceless works by Renoir, Monet, Degas and other important Impressionist painters. These exquisite slides are produced to exacting specifications in Florence on 35mm. Kodak film. They come in individual 2" x 2" mounts and can be used in any home slide projector. (If you do not own a projector, see special offer below.)

The color slides, however, are only one part of this elaborate Album. Bound into the center is an illustrated 48-page book by Albert Chatelet, Director of France's renowned Lille Museum—with a guide to each of the slide pictures and the complete story of the Impressionist era.

If this demonstration pleases you, you will be offered a new slide-and-commentary Album approximately every six weeks. Among the Albums in this series are *Italian Renaissance Painting*, the *Origins of Modern Art—Romanticism* and *Realism*—and other Albums covering every major art period.

The cost is surprisingly low

The least you might expect to pay for 24 color slides of comparable quality—if the subjects were available from museums and private collections—is $18-$24. Yet, as a subscriber to this new Program, you pay only $12.95 for each complete Album—including slides and illustrated guide book. You may take as few or as many as you like, and may stop whenever you wish.

Your Introductory Album only $1
No obligation to continue

Send no money now. We will ship your introductory Color Slide Album of Impressionist Paintings and enroll you as a trial subscriber. If you are thrilled with the demonstration, send only $1, plus a few cents for tax and shipping. Thereafter, you will be offered a new Album approximately every six weeks at the subscribers' low price of only $12.95. If not delighted, however, you may return the Introductory Album within 15 days, and owe nothing. Mail the attached card today.

If you do not have a projector: here's an unusual opportunity. We can offer you the sensational Kodak Carousel BC 604 Projector supplied with a 300-watt lamp, and 4-inch f 2.8 Ektanar lens. This top-rated projector shows all regular 2" x 2" 35mm. slides up to 1 16-inch thick. It has dependable gravity feed and you have instant access to any one of its 140-slide capacity at any time. List price $139.50—subscribers' low price only $99.50 plus tax (you SAVE $40). Send remittance with trial subscription form. If not completely delighted with the projector, return it in 15 days for full refund.



If Reply Card has been removed, write McGraw-Hill Color Slide Program of Art Enjoyment, Dept. AY-148, 1221 Ave. of the Americas, N.Y., N.Y. 10020.



GOOSE DOWN SOX

Great to wear around home or as bed and sleeping bag sox. Take little space in luggage. Bauer Goose Down quilted in tough nylon taffeta. Machine washable. **Colors,** Men's: Taupe, Red, Winter Blue. **Sizes,** Men's: S(6½-8), M(8½-10), L(10½-11½), XL(12-13). **Colors,** Women's: Winter Blue, Powder Blue, Red. **Sizes,** Women's: S(5-6½), M(7-8½), L(9-10½). **#0347** Men's or **#0348** Women's **Goose Down Sox $15.95** postpaid.

Order Today! Money Back Guarantee!

Here is my check or money order for $ _____
(Add sales tax where applicable.)

☐ #0347 Man's Goose Down Sox
Men's Size _____ Color _____

☐ #0348 Women's Goose Down Sox
Women's Size _____ Color _____

Name _____
Address _____
City _____
State _____ Zip Code _____

☐ Send me your FREE color catalog of quality outdoor apparel and equipment.

Eddie Bauer®

Dept. BNH, Fifth & Union, Seattle, WA 98124

JUST OUT! A Treasury Of Fine Tools

- 84 Colorful Pages

LEICHTUNG "THE Workbench People"
1981 Fine Tool Catalog

Inside are chisels and gouges from Germany; magnificent brass-backed saws from England; an ingenious saw-rasp from Japan; a new concept in drill bits from Austria and a fine selection of genuine Arkansas stones . . . to name just a few of over 400 special tools from around the world.

So, whether you're a serious wood worker or a do-it yourselfer, the Leichtung catalog has the tools to help you to get better results. Send for your copy today!

☐ Enclosed is $1.00. Please send me your 1981 Catalog of Fine Tools **PLUS** all catalogs and new tool bulletins **FOR THE NEXT TWO YEARS!**

Name _____
Address _____
City _____
State _____ Zip _____

LEICHTUNG, INC.
"THE Workbench People"
4944 Commerce Pky. #181NH
Cleveland, OH 44128

the old loess steppes left largely by glaciers in Europe, Asia, and America.

Although people with Neanderthal features existed before the Würm Glacial Stage, the last major glaciation of Europe, the classic Neanderthal arose with the first advance of the Würm ice sheets, lasted some 35,000 years, roughly from 70,000 to 35,000 B.C., and vanished abruptly with the first brief warm phase (interstadial) separating the first from the second major advance of the ice. The first human to successfully colonize cold landscapes, Neanderthal was a supercarnivore, killing not only some of the largest and most dangerous ungulates, such as steppe wisent, mammoth, woolly rhino, and horses, but also carnivores, such as wolves and bears.

In cold climates with long winters, living off plant food or off small mammals and birds is not a viable proposition for humans. Not only are edible plants relatively rare in cold-climate floras, but potential foods such as berries drop off in fall or they freeze and thaw and disintegrate. Tubers freeze in the soil and are impossible to excavate or even to find beneath the snow blanket. Most small mammals are hibernating or at least spending much of their time below the snow, and most birds have moved to warm climates. Moreover, to sustain a family on meat, large amounts are needed, and it becomes uneconomical to spend time hunting for small-bodied game. In cold climates, particularly in winter, it is sound economic practice to hunt large-bodied mammals only. (Large herbivorous mammals survive in winter by feeding on dried sedges, grasses, reeds, herbs, twigs, dwarf shrubs, and leaves from trees growing in protected pockets.)

Neanderthal's kill patterns, slanted heavily to large-bodied grazers and carnivores and almost devoid of small game, are beyond comparison with any modern hunting culture. Nor do Neanderthal tools match those of any culture of today, a strong hint that what these early people did will not be found in contemporary societies. This is also implied by evidence that Neanderthal was far more powerful than modern humans. Whereas archeologists can experimentally duplicate the wear pattern on tools such as were used by people from the Upper Paleolithic (the people that followed Neanderthal and are our ancestors), the wear patterns on Neanderthal's tools cannot be duplicated. We do not have the strength to do it. Neanderthal's skeleton reflects a supremely powerful musculature. The joints were massive, even in children, implying an ability for rapid starts and stops. The hands were not only very large but could also be spread wider than ours. The terminal phalanges were large, and the musculature closing the fingers was powerful. The shoulder girdle, besides being massive, was anatomically peculiar in that it was almost simian, implying brachiation (swinging through trees), which is totally incongruous with the open landscapes of the glacial age. Whatever Neanderthal did for a living, there were times when enormous physical strength and violent acceleration and deceleration of the body were essential. As Neanderthals were carnivores capable of killing very large, powerful, and agile mammals, we may look here for a clue to their distinctive anatomy.

How could one safely capture large, well-armed, aggressive, agile, big game? On an open steppe, approaching the game by stalking was hopeless, particularly if snow crunched underfoot. Even if a hunter somehow got close to the animal, how could he kill it quickly enough to prevent being gored and trampled by a wounded beast? Stalking by a single hunter was out of the question. Large, dangerous mammals are not likely to run from carnivores; on the contrary, they are likely to close the distance and attack, and herein lies their vulnerability. If a beast such as a mammoth could be provoked, it would come to the hunter. The task was to kill it without sustaining injury to oneself. A lone hunter could not succeed because the attacking animal gave him its undivided attention, and in facing the hunter it exposed virtually no vulnerable part of its body. The weapons of mammoths, bisons, giant deer, and rhinos were located frontally.

A small group of hunters would have been required to split the attention of the attacking animal, distracting it. Next, in this cooperative venture, one or more of the hunters could quickly maneuver and attack the sides of the animal where vital internal organs were more accessible to inflicted damage. The next logical step would seem to be to throw sharp, pointed spears into the prey, just as was done by our ancestors in the Upper Paleolithic. Their hafted points and spear throwers attest to that. However, Neanderthals left no evidence

of having possessed spears suitable for throwing or of any spear throwers. How then did they kill mammoths, rhinos, and bisons?

The answer requires a brief departure into combat theory. There are two principal means of avoiding damage from an animal's weapon if one cannot parry it. One either stays so far back from the beast that it cannot reach you or one gets in so close that it cannot use its weapons effectively. To escape being hurt by horses that are lined up in a stable, for example, you should either stay so far back that the occasional kicker cannot hit you or else walk along almost brushing tails with your shoulder so that a kicker cannot hurt you. The first means of defense was probably used by our Paleolithic ancestors when confronting the dangerous game that they killed by throwing spears. The second, I suggest, was used by Neanderthal. It is the key to a logical explanation of Neanderthal's morphology, hunting tools, hunting economics, and ultimate demise. I have termed it "close-quarter confrontation hunting."

The advantage offered by close-quarter confrontation hunting with primitive weapons was that it would require few hunters; probably two would do. Extraordinary agility, coupled with high speed and precision of movement, would have been required, however, for one of the hunters to avoid the weapons of an attacking animal. First, he had to evade the attacks, then quickly move in, attach himself to the body of the prey, and have the strength to hold on while an enraged beast tried to fling, shake, and buck him off. With one hunter attached to the prey and holding its attention, the other was free to kill the distracted beast. The hunter should not have been armed with a spear featuring a narrow stone blade, which was a must on throwing spears in order to achieve penetration. Such a blade could shatter on a bone, disarming the hunter. A spear might also completely penetrate the prey and possibly skewer the hunter holding on to the animal on the other side. Also, the wound channel caused by a throwing spear is thin, and so not conducive to quick killing. What was required was the largest possible blade that could be thrust into the prey. Such a blade inflicted a massive wound channel and could strike bones without fracturing. Until the prey weakened and fell, the hunter clinging to it

What your home could have in common with the Met, the Tate, and the Louvre.



Tjelda Michas' *Oriental Poppy*

Beautiful, original works by artists who are represented in the world's great museums and galleries can be yours for very reasonable prices.

We offer original etchings, lithographs, and serigraphs signed by Calder, Chagall, Dali, Miro, Renoir, Vasarely, and other important artists.

Tjelda Michas' vibrant still life, *Oriental Poppy*, is just one of the many fine prints we've recently made available.

Our expert advice and full money-back guarantee are your assurances that the art you buy will have lasting value and beauty.

Send for our colorful, descriptive catalog without obligation.

Original print collectors group, Ltd.

215 LEXINGTON AVE., DEPT. NH-26, NEW YORK, N.Y. 10016

PLEASE SEND ME YOUR FREE COLOR CATALOG AND LATEST NEWSLETTER.

NAME _____ PLEASE PRINT

ADDRESS _____

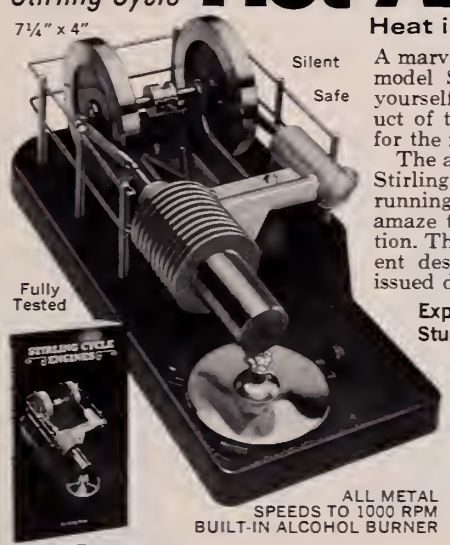
CITY _____ STATE _____ ZIP _____

© 1981 OPCG, LTD

The Amazing Stirling Cycle **Hot Air Engine**

Heat is the only fuel required!

7¼" x 4"



Silent

Safe

Fully Tested

ALL METAL
SPEEDS TO 1000 RPM
BUILT-IN ALCOHOL BURNER

A marvelous opportunity to acquire an early model Stirling Cycle Engine and acquaint yourself with little known facts about a product of the past that may well hold promise for the future.

The average person has never heard of the Stirling engine, so the sight of one quietly running with heat as its only fuel will at first amaze them and then excite their imagination. This is the first in a family of six different desk-top model hot air engines to be issued during the next three years.

Experimenters • Hobbyists' Power Source
Students • Collectors • Model Engineers

An easily read, lavishly illustrated, 128-page book accompanies each engine or may be purchased separately. This publication, the first of its kind, takes the reader on a 160-year tour through the world of Stirling Cycle Engines. Illustrations include the Stirling, Roper, Heinrici and the amazing new Stirling-powered Ford Torino!

Solar Engines • 4020 East McDowell Road, Phoenix, AZ 85008 U.S.A. (602) 274-3541

Please send me.

_____ Engine and Book @ $38.50 . . . $_____

_____ Book (separately) @ $ 5.50 . . . $_____

Enclosed
☐ Check ☐ Money Order
Charge My
☐ American Express ☐ VISA
☐ Diners ☐ Master Charge

(Domestic shipments sent postpaid. International (airmail) please add: $11.00 for Engine; $2.00 for Book only.)

TOTAL $_____

INTERBANK NO. _____

CARD NO. _____

EXPIRATION DATE _____

SIGNATURE _____

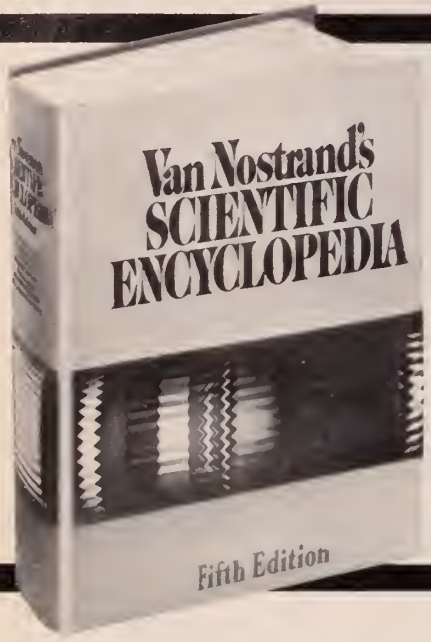
NAME (PLEASE PRINT) _____

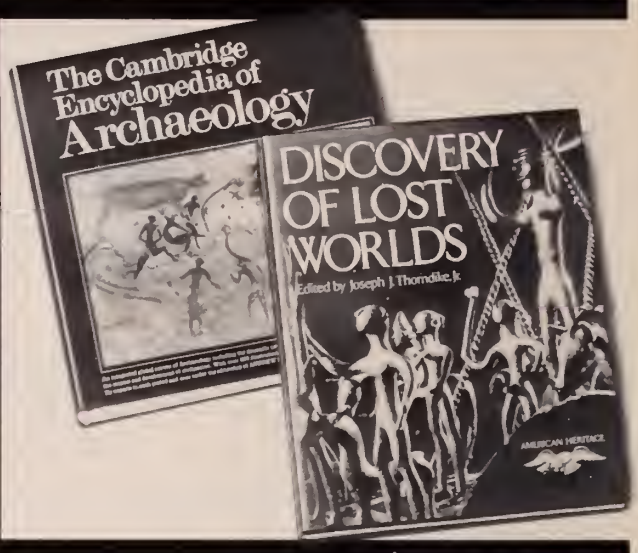
ADDRESS _____

CITY _____ STATE _____ ZIP _____ NH-1

CREDIT CARD BUYERS DIAL: (800) 528-6048

5 good reasons for joining the
Natural Science Book Club



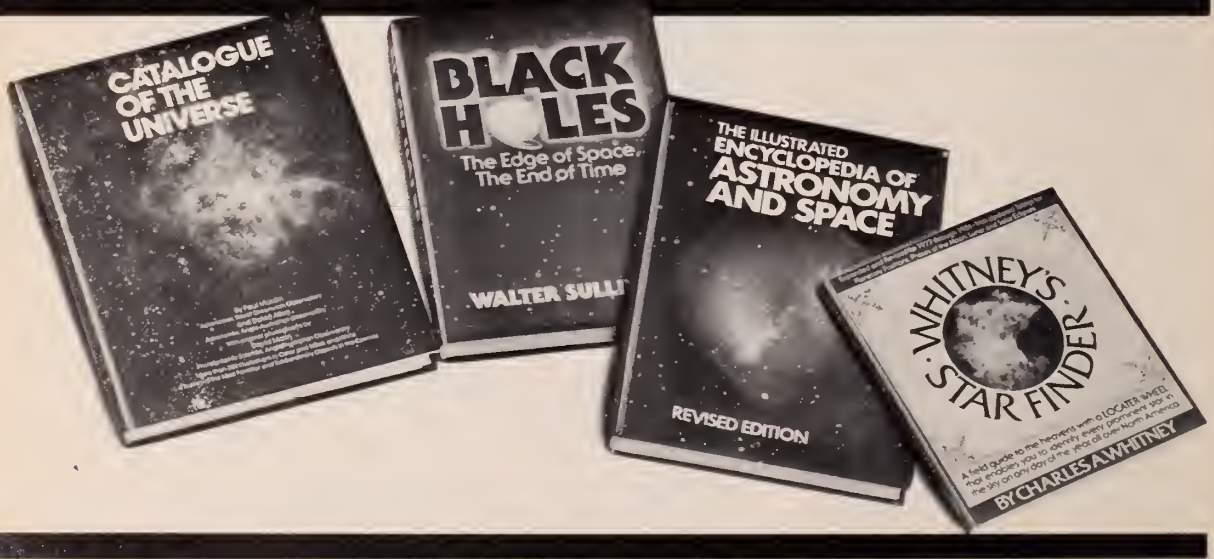


1. Van Nostrand's Scientific Encyclopedia

Edited by Douglas M. Considine. Nearly 200 experts have contributed to this thoroughly revised and greatly expanded fifth edition of the most authoritative single-volume source of scientific knowledge ever assembled. Enormous 9¼″ × 12″ volume contains 2.2 million words, 2382 pages, 2500 photographs, drawings, and charts, and 500 tables. 7200 articles cover everything from the earth and space sciences to energy technology, from the life sciences to mathematics, from the information sciences to physics and chemistry. ". . . an amazing book . . . for both the general and scientific reader."—*The New York Times.* **Publishers' Price $69.50**

2. Archaeology Library

Two extensively illustrated volumes provide a panoramic overview of ancient cultures. ***The Cambridge Encyclopedia of Archaeology***— an oversized reference with more than 400 photos, drawings, maps, and plans. Includes writings by 55 experts. ***Discovery of Lost Worlds***—the major archaeological finds of the past 300 years recreated in the writings of well-known scholars. Beautifully illustrated. **Publishers' Price $69.90**



3. Basic Astronomy Library

Four books that will provide you with a basic, well-rounded library. Start with ***Catalogue of the Universe.*** Three-volumes-in-one: an atlas, encyclopedia and book of descriptive astronomy. Surveys over 220 astronomical objects. More than 300 photographs. ***Black Holes: The Edge of Space, The End of Time. Whitney's Star Finder*** enables you to identify every major star in the sky over North America. ***The Illustrated Encyclopedia of Astronomy and Space*** contains over 1000 entries and 150 photographs and illustrations. **Publishers' Price $60.80**



4. Ancient Civilizations

A four-volume set including ***The Archaeology of Greece: An Introduction.*** A remarkable historical and artistic account of the splendor of ancient Greece. 334 black and white photographs. Plus, 8 pages of color plates. ***Ancient Egypt***—a fascinating survey of Egyptian civilization, contains 125 photographs. ***Stonehenge and Its Mysteries***—over 200 maps, diagrams and photographs. ***The Maya.*** The extraordinary Mayan civilization. Includes all the latest discoveries. Over 140 illustrations. **Publishers' Price $81.80**



5. Natural History Library

A carefully selected three-volume set consisting of ***Deadly Beautiful: The World's Most Poisonous Plants and Animals.*** A breathtaking survey of toxic reptiles, insects, plants, fruit and fish. Illustrated with 250 photographs, many in color. ***The Spotter's Guides***—a set of six colorful field guides: Birds; Trees; Wild Flowers; Rocks and Minerals; Shells; The Night Sky; ***Fossils of All Ages***—a superb collection of photographs reveals the history of fossils, how they are formed, what they consist of and the rules that dictate their shape and symmetry. **Publishers' Price $76.65**

Take either Van Nostrand's Scientific Encyclopedia or any one of these other 4 outstanding Sets for only $2.97

(values to $81.80)

if you will join now for a trial period and agree to take 3 more books—at handsome discounts—over the next 12 months.

As a member, you'll be kept informed of the most interesting, most important science books being published. You'll get to choose from a dazzling array of books—from fascinating accounts of the discovery of lost civilizations to speculations on the origin of our universe, from beautifully illustrated books on the world of nature to stimulating books on where man came from and where he is going. Join now and see for yourself.

MEMBERSHIP BENEFITS • In addition to getting either Van Nostrand's Scientific Encyclopedia or any one of these 4 outstanding Libraries for only $2.97 when you join, you keep saving substantially on the books you buy. • Also, you will immediately become eligible to participate in our Bonus Book plan, with savings of at least 70% off the publishers' prices. • At 3-4 week intervals, (16 times per year) you will receive the Book Club News, describing the coming Main Selection and Alternate Selections, together with a dated reply card. • If you want the Main Selection do nothing and it will be mailed to you automatically. • If you prefer another selection, or no book at all, simply indicate your choice on the card, and return it by the date specified. • You will have at least 10 days to decide. If, because of late mail delivery of the News, you should receive a book you do not want, we guarantee return postage.

Natural Science Book Club 4-AK8
Riverside, N.J. 08075

Please accept my application for trial membership and send me either Van Nostrand's Scientific Encyclopedia or any one of the four libraries, billing me only $2.97. I agree to purchase at least three additional Selections or Alternates over the next 12 months. Savings range up to 30% and occasionally even more. My membership is cancelable any time after I buy these three books. A shipping and handling charge is added to all shipments.

Check which one you want:
- ☐ Van Nostrand's Scientific Encyclopedia (00470-3).
- ☐ Archaeology Library-A (10130)
- ☐ Ancient Civilizations-A (10106)
- ☐ Natural History Library-A (10111)
- ☐ Basic Astronomy Library-E (10150)

No-Risk Guarantee: If you are not satisfied—for any reason—you may return your introductory books within 10 days and your membership will be canceled and you will owe nothing.

Name _____

Address _____

City _____

State _____ Zip _____

(Offer good in Continental U.S. and Canada only. Prices slightly higher in Canada.)

needed the endurance to hold on no matter how violent the motions of the prey. To loosen his hold would have jeopardized his life, as well as that of his companion or companions.

If great strength, agility, and precision and speed of bodily movements were required for such a hunting technique, those parts of the brain controlling motor functions in the hunter had to be greatly developed. Neanderthal possessed a massive cerebellum and motor cortex compared to modern humans. This pulled the brain case rearward, creating an occiput that reached farther rearward than in modern humans, explaining, in part, the large, long, low brain case and bun-shaped occiput of the Neanderthals. Experimental evidence shows that, phenotypically, brain size is a function of the diversity of well-mastered motor patterns, as well as a result of good nutrition. The build and condition of the bones of Neanderthals speak for exceedingly good nutrition and a great deal of exercise. (This also applies to females, who were, as in modern humans, somewhat smaller than males. They, too, were apparently well-muscled.) I submit that the brain size and shape of these people fit with the demands of close-quarter confrontation hunting.

Given all of the preceding conjectures, Neanderthal hunters would have done best to focus on large mammals with long hair, allowing for a solid handgrip. Mammoths, woolly rhinos, steppe wisent, and horses were such animals. Compared with us, Neanderthal's hand not only covered a great span but the long, broad-tipped fingers offered a greater surface area with which to hold hair. Neanderthal man's powerful adductor muscles, great ability to spread his fingers, and big, fleshy fingertips now have a logical explanation. So do his massive arms and "brachiating" shoulder girdle.

Examination of kill patterns shows that Neanderthals rarely killed aurochs (*Bos primigenius*), the ancestor of domestic cattle, and moose. Cattle have a short-haired smooth surface, difficult to grasp and to hold on to. Also, their ability to spin around in a tiny space, buck effectively, and attack can be attested to by anybody visiting a rodeo. Moose hair breaks or pulls out. But both moose and cattle could be killed by hunters using throwing spears, and Upper Paleolithic hunters killed these two species regularly. Thus the paucity of cattle and moose kills in the Mousterian (Neanderthal) layers in Ukrainian and Russian sites may be explained as a consequence of the postulated hunting methods of Neanderthal. There is no reason to suspect that aurochs and moose were rare in Neanderthal's time and common in the Upper Paleolithic.

For killing rapidly at close quarters, as indicated earlier, a thin-bladed throwing spear may not only be ineffective but also dangerous. Ideally, a hafted blade on a thrusting spear should be as wide as the strength of the hunter permits him to thrust it through a thick hide, muscles, and fat. The boar spear from medieval Europe shows the solution to the problem of quickly killing a big, violent, tough creature. The blade is thick, some three inches across the edge, with a rounded point—very similar to the big, thick, massive Mousterian points. We know that Neanderthals worked in wood, sufficient reason for us to suspect that they could make handmade thrusting spears. Refined workmanship would add nothing to the effectiveness of the blade. We also know that Neanderthal people made hand axes, which they embedded partially into mastic, a material made from clay and tree resins. Without the mastic cap, the hand axes would, of course, have cut the hand. These axes must have been used with great force. Such an ax could be used to crush the lumbar vertebrae of a steppe wisent or horse with one blow, slash open a chest cavity, or cut the tendon on a hindleg of the prey. Thus Neanderthal's weapons, morphology, and kill patterns fall logically within a close-quarter confrontation hunting strategy.

The dentition of Neanderthal people and their peculiar hearths are linked to some consequence of killing game with primitive weapons in cold climates. Large mammals killed in winter had to be dismembered quickly before they froze. After the cut meat froze, the chunks had to be carried to a convenient shelter. The chunks of frozen meat were most likely thawed and roasted by placing them directly into a bed of coals in a large hearth. This had several consequences. First, the meat came in contact with ashes, sand, and bone grit. Eating such meat would have caused tooth abrasion. The open-rooted and possibly continually growing cheek teeth of Neanderthal are the logical correlate to such abrasive food. Singed and charred meat had to be forcefully removed from layers that were still raw and frozen. This meant that either the meat was somehow cut off or that the person bit directly into the joint and worried off a piece of meat. The latter requires powerful incisors and a sawing motion of the jaw amenable to severing tough, fibrous meat. The jaw anatomy indicates that a backward and forward movement of the jaw existed—admirably suited for grinding incisors against one another. Thus Neanderthal's projecting jaws and large incisors would function admirably for working free amounts of tough meat from joints. Such use of the front teeth should not only lead to heavy wear but also to noticeable wear on the front of the incisors. The fossil evidence verifies this.

Another consequence of bringing crudely severed joints to a fire was an accumulation of bones. To leave bones about a campsite would attract bears or other carnivores. Burning all bones not only removed the attraction, but would also result in large hearths filled with bone ash so typical of Neanderthal hearths.

To understand their demise, one must go a little further in unraveling the way Neanderthals lived. There is no evidence for Neanderthals, as there is for Upper Paleolithic people, having killed much in excess and preserved the surplus meat. Neanderthals probably lived from kill to kill. In winter, without a reliable surplus of stored food to fall back on, they could not afford to stay where the occurrence of game was unpredictable. They could only survive in winter by living in areas with a high density and diversity of large mammals. They must, therefore, have been confined to the most productive localities. This implies that under comparable conditions Neanderthals would have had a more restricted geographical distribution than Upper Paleolithic people.

Further, without the practice of storing surplus food or boiling bones to extract the protein, Neanderthals were less likely to be as efficient in utilizing carcasses as were people from the Upper Paleolithic. Since there is no evidence for sophisticated clothing or shelters, we may assume that Neanderthal people—like people living in the high Andes—kept warm by eating more food. Compared with the Upper Paleolithic people, Neanderthal people would have had to hunt more. They must have been very sen-

HOW TO FOIL A CAR THIEF

A FEW SIMPLE PRECAUTIONS CAN REDUCE THE RISK OF THEFT

The numbers are staggering. Every 37 seconds or so a car is stolen somewhere in the U.S. That adds up to almost 800,000 cars a year. But you can do something to keep your car from becoming a statistic. Start by avoiding these four common parking mistakes.

The "Just for a Minute" Syndrome. When you leave your car, even if it's "just for a minute," lock all of the doors and take your keys. In fact, about one of every five cars stolen was left unattended with keys in the ignition. Keep driver's license and vehicle registration cards in your wallet or purse. If a car thief finds these documents in the vehicle's glove box, he can impersonate you if stopped by the police.

The Isolated Location. It's safest to park in a locked garage, but if you can't, don't leave your car in a dark, out-of-the-way spot. Instead, try to park on a busy, well-lighted street. Thieves shy away from tampering with a car if there's a high risk of being spotted.

The Display Case. There's nothing more inviting to a thief than expensive items lying in your car, in plain sight. If you lock these items in the trunk or glove box, there's less incentive for a thief to break in. Also, when you park in a commercial lot or garage, be cautious. Lock your valuables in the trunk, and leave only the ignition key with the attendant.

The Space at the End of the Block. In recent years, professional car-theft operations have become an increasing problem. Unlike amateurs, the professionals are not easily deterred. Cars parked at the end of a block are easy targets for the professional thief with a tow truck. So, it's best to park in the middle of the block. Be sure to turn your steering wheel sharply to one side or the other. That will lock the steering column and prevent the car from being towed from the rear.

Unfortunately, there's no such thing as a "theft-proof" car. But at General Motors, we're equipping every car we build with anti-theft features. We want to help you make it as difficult as possible for any thief—amateur or professional—to steal your car.

This advertisement is part of our continuing effort to give customers useful information about their cars and trucks and the company that builds them.

General Motors

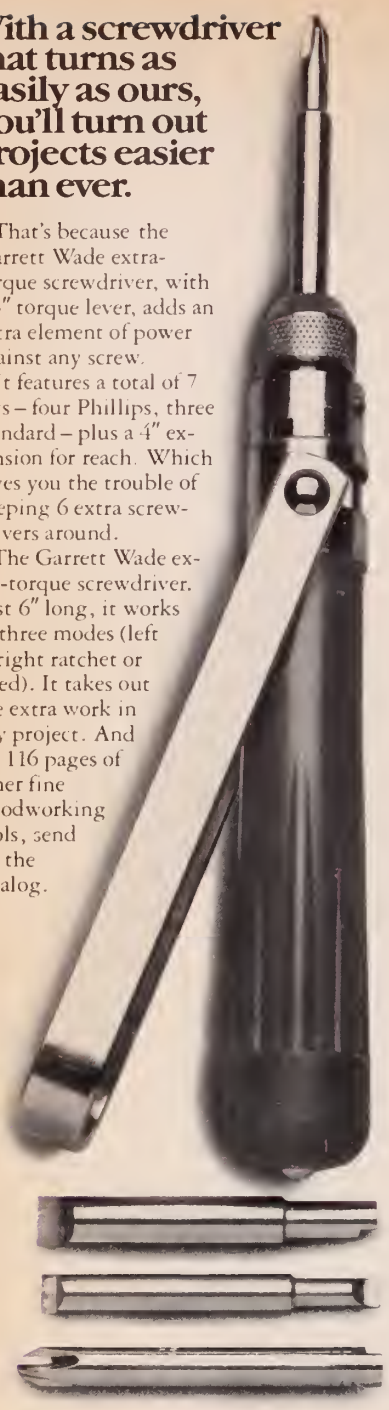
People building transportation to serve people

With a screwdriver that turns as easily as ours, you'll turn out projects easier than ever.

That's because the Garrett Wade extra-torque screwdriver, with a 3" torque lever, adds an extra element of power against any screw.

It features a total of 7 bits – four Phillips, three standard – plus a 4" extension for reach. Which saves you the trouble of keeping 6 extra screwdrivers around.

The Garrett Wade extra-torque screwdriver. Just 6" long, it works in three modes (left or right ratchet or fixed). It takes out the extra work in any project. And for 116 pages of other fine woodworking tools, send for the catalog.



Offer expires September 15, 1981

Garrett Wade Co.,
Dept. NH-1-81
161 Ave. of the Americas
N.Y., N.Y. 10013

☐ Please send me____extra-torque screwdriver(s) @ $26.90 p.p.d. each
☐ Please send me____new Garrett Wade catalog(s) @ $1 (free with torque screwdriver order)
☐ Check or money order enclosed
☐ Visa/Master Charge/American Express
_____Amount enclosed (Add sales tax for NY State residents)

Card No._____Expires_____
NAME_____
ADDRESS_____
CITY_____
STATE_____ZIP_____

sitive to changes in game densities. This predicts that compared with the Upper Paleolithic people, Neanderthals lived at lower densities, rarely formed large groups, and only exceptionally lived in communal dwellings. This is supported in part by the Russian archeological record; the camps of Neanderthal man are about one-fifth as frequent as those from the Upper Paleolithic, although the latter period was the shorter.

The first retreat of the Würm ice was followed by a brief but very warm interstadial period. (The extent of glacial melting is attested by the fact that ocean shorelines were much higher 35,000 years ago than they are today.) Forests rapidly replaced loess steppes and grasslands. This would have caused the once large herds of grazers to become depleted and fragmented. As the grazers with shaggy coats grew scarce, the geographical range of Neanderthal people must have shrunk rapidly. The last of the Neanderthals exhibited reduced body growth, a sign of inadequate nutrition. They probably went extinct in a short period.

A glaciation later, the same fate nearly befell the culturally and technologically sophisticated Upper Paleolithic people. They came close to extinction during the terrible Mesolithic period that followed the glaciation. Population size in Europe shrank, people were poorly grown, diseased, and short-lived. Homicide and cannibalism were common. However, the technology changed, new ecosytems such as the marine shores and freshwater deltas were exploited, and our kind survived. Neanderthal people, by comparison, were more biologically, and less culturally, adapted to their role in glacial landscapes. They were, therefore, not primitive humans. On the contrary, Neanderthal was more specialized biologically for the role of a superpredator than we are, and consequently is the most specialized human from the past. It was probably only after the Neanderthals' extinction that modern people could colonize the land they once roamed over, for they must have been fighters of stunning abilities, for whom Upper Paleolithic people were no match.

Valerius Geist is associate dean in the Faculty of Environmental Design of the University of Calgary. He is an authority on the ecology of ungulates, particularly goats and deer.



For centuries man feared it, made sacrifices to it, wailed over it. Now we run to greet it. You are extended a unique invitation to witness one of nature's most awesome spectacles, a total eclipse of the sun. On July 31, 1981 the British cruise ship, m.s. Coral Princess will be positioned 1000 miles off the coast of Japan to rendezvous with eclipse totality.

The ORIENT ECLIPSE CRUISE and expedition is the sequel to the six previous historic VOYAGE TO DARKNESS eclipse expeditions which successfully intercepted totality off the coasts of Nova Scotia, Africa, the Caribbean, in the Pacific and at Montana's Big Sky eclipse expedition.

The ORIENT ECLIPSE CRUISE adventure offers a distinguished staff of shipboard lecturers (including meteorologist Dr. Edward M. Brooks) scientific, cultural and educational programs, and tours of Japan, Hong Kong, Macau and China.

Join us as we probe earth, sea and space for yet another exciting and memorable cosmic adventure as we sail into totality and beyond.



ORIENT ECLIPSE CRUISE

Voyage to Darkness VII

Orient Eclipse Cruises, Inc.
1080 Fifth Avenue
New York, N.Y. 10028

Please send me more information on the ORIENT ECLIPSE CRUISE

Name_____
Address_____
City_____
State_____Zip_____



THE NEW SCHOOL IS ANTI-FOSSIL.

We have nothing against your Jurassic, your Triassic, or your Upper or Lower Cretaceous models. The kind of fossilization we hate to see is the sort that takes place in *Homo sapiens,* usually from the neck up.

As any dinosaur will tell you, being a fossil is no fun. And, happily, it's a fate easily avoided. At The New School, we ward off mental petrification with more than 1700 courses this spring, everything from astronomy to yoga: courses in social sciences, pure and applied sciences, humanities, languages, creative and performing arts, business and finance, and, through Parsons School of Design, art and design.

Fossils belong in museums. Anti-fossils belong at The New School. Mail the coupon below, or call

(212) 582-5555

24 hours a day, 7 days a week. Either way gets you a copy of our spring semester bulletin.

New School
66 W 12th St
N Y 10011

Please send me the 1981 Spring Bulletin.

Name_____

Address_____

City_____ State_____ Zip_____

NH181

66 West 12th Street **New School** New York, N.Y. 10011

British Museum (Natural History)

A century ago, a new museum was built to house the British Museum's crowded, cobwebbed natural history collections. Since then, the London museum has become one of the world's great scientific institutions

by William E. Swinton
photographs by Lee Boltin

This year, one of the world's great scientific institutions, London's Natural History Museum, is celebrating one hundred years as a separate museum. The British Museum (Natural History), as it is officially called, is best known for its role in education and the richness of its exhibitions, but as is true of so many fine museums, scientific research constitutes the bulk of the work carried out within its walls and on the expeditions and fieldwork it sponsors. For both of these functions—the educational and the scientific—the men and women who work in the museum today, and the visitors who throng its impressive halls, owe a tremendous debt to the men who brought the museum to life one hundred years ago.

For more than a century the Natural History Museum had been an integral part of the British Museum in Bloomsbury, one and a half miles north of Charing Cross. By the middle of the nineteenth century, however, the growing collections of minerals, plants, fishes, fossils, and other treasures had put so much pressure on the limited space available in Bloomsbury that the decision was reached to house the natural history collections separately. From 1880 to 1883 the Natural History Museum moved from its crowded quarters in the British Museum into a new home, complete with towers, spires, and navelike central hall, in South Kensington, three and a half miles west of Charing Cross.

The history of both the "new" Natural History Museum and its parent, the British Museum, began in 1753 with a single Act of Parliament. The act authorized the purchase of the collections of the distinguished and wealthy physician Sir Hans Sloane (1660–1753), and thus founded the British Museum. President of the Royal Society, president of the College of Physicians, physician general of the army, and physician to the queen, Sloane was also a botanist and avid collector. Montagu House, his home in Bloomsbury, became the new British Museum and housed the natural history collections until shortage of space necessitated the move to South Kensington.

Sloane was a member of Britain's oldest natural history society, the Temple Coffee House Botanic Club, founded in 1689. The members of this organization approached their subject with boundless enthusiasm, combing the local countryside for plants and animals and meeting incoming ships to beg the sailors and passengers for exotic specimens. The collections that resulted were often heterogeneous and of little true scientific value. Sloane's collections were in better shape than most, but since no arrangements had been made for their preservation, many of the specimens perished during the museum's early days in Bloomsbury. Nonetheless, natural history specimens were plentifully represented in the new museum.



Hans Sloane
The Bettmann Archive

Identification of specimens in the collections presented a great challenge, however. Carolus Linnaeus, the great eighteenth-century Swedish botanist and physician, had met Sloane on a visit to London in 1736 and been much impressed with his collections. By helpful coincidence, 1753, the year that the British Museum was born, was also the year that Linnaeus published his *Species Plantarum*. In 1758, his *Systema Naturae*, regarded as the basis of modern zoological nomenclature, appeared in its tenth edition. In Europe at least, collected specimens could now be named in an understandable manner, an advance that did much to promote scientific and medical understanding.

The museum's early vicissitudes are well recorded. It was short of money, short of space, and short of staff. What staff the museum did have was usually volunteer and often included a large proportion of nonpracticing physicians—not surprising in a time when a medical degree was largely a degree in natural history. More than a century after the founding of the British Mu-





Carolus Linnaeus
The Bettmann Archive

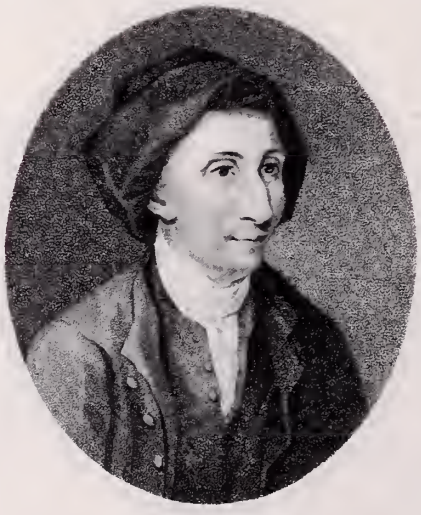
seum, Prime Minister Gladstone, during an escorted tour of the museum, was astonished to hear that people were actually paid to work there.

Not everyone appreciated the visual encyclopedia beginning to take shape in Bloomsbury. In William Makepeace Thackeray's *The Virginians*, one character expresses the critical opinion that some Londoners held of the new museum: "By George, I don't know where the town's running. There's Montagu House made into a confounded Don Saltero's Museum, with books and stuffed birds and rhinoceroses." (The catalog of Don Saltero's Museum, a once popular London museum, is now owned by the British Museum.)

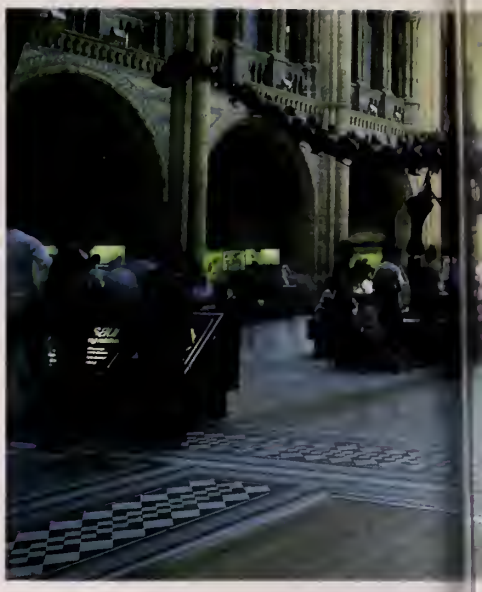
The new museum was, indeed, no bonanza for the public. Only small parties of "respectable" people were allowed in for guided tours that lasted half an hour. Yet around the country, more and more respectable people, especially the landed classes, were becoming interested in gardens and horticulture and in the frequently lavish books being published on these subjects. Similarly, as the museum's collections grew, so did the number of people who, influenced by the increasingly popular fields of archeology and the natural sciences, wanted to see for themselves the bounty of nature housed in the museum.

The names of the early keepers of the Natural History Department in Bloomsbury may mean little today, but they belong to men who were important in the formation of the museum and in the scientific world of the time. For example, the keeper from 1765 to 1773 was Matthew Maty, a Dutch physician from Leiden, who as a fellow of the Royal Society and, later, foreign secretary of that distinguished body was scientifically influential. He apparently had an aversion to museum visitors and doled out passes reluctantly. His successor was the great botanist Daniel Solander, a favorite student of Linnaeus. Coming from Sweden, Solander played an important part in introducing the Linnaean system to Britain. Learned and urbane, he traveled around the world with Capt. James Cook and Sir Joseph Banks, botanist and patron of the sciences. Solander's influence on the museum was great, and his participation in the intellectual activities of the time, including membership in the Royal Society and the Lunar Society, enhanced the prestige of the museum and brought additions to its collections.

The last of the early keepers of the Natural History Department, E.W. Gray, saw the museum through the change of centuries. As it moved into a wonderful era of new knowledge, the museum struggled to keep its collections in some semblance of order. The department was expanded and given a new name: Department of Natural History and Modern Curiosities. Its first keeper, George Shaw, was given no money to go with this long title, however, and so, he "wrote for booksellers." Accounts of the collections report that owing to inevitable neglect, "the basements of Bloomsbury resemble the catacombs at Palermo, where one is opened every day of the year, merely to deposit fresh subjects for decay." Some of the more



Matthew Maty
The Grenger Collection



decayed specimens in the Sloane collection had to be burned.

But then the intellectual spring arrived. In 1807 the Geological Society of London was founded, and in 1826 the Zoological Society of London. John James Audubon's *Birds of America* was published in London in 1827, and Charles Lyell's *Principles of Geology* appeared in 1830, the same year the Royal Geographical Society was founded. The next year, at York in the northeast of England, the British Association for the Advancement of Science was inaugurated, and in the city of Plymouth in the southwest, a young naturalist named Charles Darwin stepped on board a little ship called the *Beagle*. In 1833, the Royal Entomological Society opened its doors, followed by the Botanical Society of the British Isles in 1836. Britain's scientific community was never to be the same. Specimen logged and cobwebbed as it was, the British Museum enjoyed a growing reputation during this period. In 1818, William MacGillivray, age twenty-three, walked the eight hundred miles from Aberdeen, Scotland, to London in six weeks just to see the museum's natural history collections. Apparently satisfied with his visit, he returned by boat to Aberdeen, where he became professor of natural history. Charles Darwin, writing to his sister in 1833 about the wonders of South America, claimed that if he had not been able to undertake his travels, he "would be a ghost and haunt the British Museum."

Throughout the first half of the nineteenth century, the museum grew







Above left: Diplodocus *(left) and* Triceratops *(right) grace the Natural History Museum's central hall. Above: In the museum's taxidermy and model-making department, situated in a separate building on the outskirts of London, a mule is readied for Origin of Species, an exhibit to open in May. The Irish wolfhound, seemingly alert to the activity around it, is proof of the department's skill; it too is part of the new exhibit. Left: I.W.B. Nye of the Department of Entomology compares a male specimen of* Thysania agrippina, *the world's largest moth, with the earliest illustration of the species, in P. Cramer's* Uitlandsche Kapellen, *1776.*

and changed: collections merged, keepers retired or transferred to new departments, new keepers joined the staff. In 1853, the Zoological Society of London decided to give up its own museum and presented its type specimens to the British Museum. The whole structure of the Natural History Department changed in 1856, so that it became virtually a separate museum within the museum. In May of 1856, when Richard Owen was appointed the department's first superintendent, great changes were imminent.

Richard Owen (1804–92) was perhaps the greatest anatomist of Victorian times, despite an implacable opposition to Darwin's theory of evolution by natural selection. A physician and fellow of the Royal Society, he had been in charge of the John Hunter collection and others at the Royal College of Surgeons, where he was professor of comparative anatomy. Also a paleontologist, he came to the Natural History Department as a professional, and he realized that to make order out of chaos, he would have to find more space. Owen was not the first to come to this conclusion, but he pressed the matter relentlessly, and since there was no room to expand the facilities in Bloomsbury, he sought a separate site at South Kensington. His first proposal was turned down by the government in 1860 on financial grounds, but in 1862 twelve acres of the 1862 International Exhibition by the Cromwell Road were acquired for the purpose of establishing a new home for the Department of Natural History.

The first architect chosen to design the new museum building was Capt. Francis Fowke of the Royal Engineers. The museum trustees rejected his plans, however, and in 1865 he died while amending them. Alfred Waterhouse was approached in 1866 and eventually agreed to undertake the demanding task, but it was 1871 before his plans were approved by the trustees and 1873 before construction began. The new building was more or less ready by 1880, and in April of 1881, the museum was officially in business.





Most large Victorian buildings were either cathedrals or railway stations, and the Romanesque-inspired Natural History Museum in South Kensington, with its great hall and stained-glass windows in its side galleries, conformed to these models. The building's unusual façade was encased in terra cotta, a kiln-burned clay so fine that the grime of London could not infiltrate it. The upper part of the east wing was decorated with representations of animals of the past, that of the west wing with modern organisms—a separation of fossil and living organisms that reflected Owen's original plan for the public galleries. Man was perched at the peak of the roof above the entrance. Unfortunately, the grand design provided no space for a working staff or for specimens preserved in spirits; no room for large mammals such as whales, except in the entrance hall; and almost no space for a library.

Filling the new space with the old collections took nearly three years, but Owen did not stay to see it all. In the fall of 1883, he wrote in his diary:

> With this year end my official relations with the national collections of natural history, the several collections,—Zoology, Geology, Fossils, Minerals, Plants,—being arranged and displayed in their respective galleries. I felt that I could now "depart in peace" for mine eyes had seen *their* salvation.

On his retirement from the museum on January 5, 1884, Queen Victoria made Owen, then in his eightieth year, knight commander of the Bath.

Owen was succeeded at the Natural History Museum by a true museum man, William Henry Flower. Qualified medically in London's University College Hospital, Flower was a medalist in physiology and zoology, had served as a medical officer in the Crimea, and was the first of the museum's leaders to have extensive museum training. Curator for a time of a small medical museum, in 1861 he became curator of the Hunterian Museum at the Royal College of Surgeons. In his twenty-three years in this post, he reorganized the collections, increased the displays, and wrote on mammalian anatomy. In 1870 he succeeded Thomas Huxley as professor of comparative anatomy and physiology at the college, and in 1879 he was appointed president of the Zoological So-



The Natural History Museum's rare book collection includes, right, a first edition of Linnaeus's Systema Naturae; *sketches and drawings by Sydney Parkinson, who accompanied Captain Cook on his first voyage; and a handwriting collection used to verify signatures. In recent years, the museum has opened several imaginative exhibits. The bright, explicit graphics in Human Biology, below, were controversial when this exhibit opened. The modern design of Introducing Ecology, below right, provides a sharp contrast to the museum's architectural style.*





ciety of London, a position he held for twenty years.

Thus, when Flower came to the museum in 1884, he was uniquely qualified for a unique post, the first directorship of the new museum. Almost at once he brought a new sense of purpose to the task, understanding that he had in his hands a wonderful instrument of public instruction and inspiration. He set about creating exhibitions that would teach rather than simply display and devised the "Index Museum," a series of exhibits in the central hall that illustrated comparative anatomy.

With its growing role in education and a policy of free admission, the museum took on a public look. The realization that without an audience to charm, influence, and inform, the museum was largely mute had been a long time coming. The possibilities for conducting research in the museum, never overlooked by Flower, were increased by the favorable public reaction and by the gifts of collections. Flower became active in spreading his new gospel of museums, using his presidency of the Zoological Society and of sections of the British Association to reach a wider and more influential audience. He published on museums as well as on mammals and supported the formation in 1889 of the Museums Association, which has since reached across the world with its journal and professional examinations.

Through the end of the nineteenth century and the beginning of the twentieth, the museum prospered as its departmental structure became increasingly well defined. During this





Daniel Solander
The Granger Collection

period the keepers of the museum were men of great distinction, all of them fellows of the Royal Society. Their participation in influential organizations brought new collections and new forms of technology to the museum and helped attract ambitious young people to the careers that the museum could now offer. The prestigious collections were continually outgrowing the study rooms, storerooms, and narrow galleries allocated to them. In fact, several collections, including the diaries, notebooks, and marine deposits from famous oceanographer Sir John Murray's round the world voyage aboard HMS *Challenger* (1872–76), were set up in small, separate buildings of their own.

The growth of the collections called for skilled curators, and joining the scientific staff became a more difficult undertaking. Applicants were required to have a good degree in the appropriate subject and had to be nominated for entry by one of the museum's principal trustees. Only after passing an interview were they permitted to sit a civil service examination. While this system more or less assured that staff members understood the subject on which they were to work, it provided no guarantee of curatorial interest or ability.

The collecting instinct, a crucial element in the making of an able curator, is rooted deep in the human psyche. In *The Little Universe of Man* (1978), biologist Cyril Dean Darlington discusses this instinct and its proper role in modern science:

> The instinct for collecting, which began as in other animals as an adaptive property, could always in man spread beyond reason; it could become a hoarding mania. But in its normal form it provides a means of livelihood at the hunting and collecting stage of human evolution. It is then attached to a variety of rational aptitudes, above all in observing, classifying, and naming plants, animals, and minerals, skills diversely displayed by primitive peoples. These skills with an instinctive beginning were the foundation of most of the civilized arts and sciences. Attached to other skills in advanced societies they promote the formation of museums and libraries; detached, they lead to acquisition and classification by eccentric individuals, often without any purpose or value at all.

Darlington's remarks point up another problem all museums face: what to do with growing and aging collections. At the turn of the century the Natural History Museum still had collections of Charles Darwin, Alfred Wallace, John Gould, and others—benefactors, collectors, scientists, and eccentrics. What should be done with them? Should they be treated as historical relics, too precious to handle, or used, carefully, as steppingstones to more modern knowledge? The wall cases in the South Kensington museum, deep, dark, and high, were obviously not made for human faculties of perception, and the table cases, suitable enough for exhibiting relatively small objects and storing others, often served as barriers to divide the staff workrooms from the wandering public. To relieve part of the problem, the museum soon extended a warmer welcome to the public.

In July 1913, some thirty years after the new Natural History Museum was furnished, a pamphlet entitled *The Public Utility of Museums* was published. Intended to "call the attention of all Local Authorities to the desirability of the Public having the



Richard Owen
The Granger Collection



William Henry Flower
The Granger Collection

means of obtaining information at all Museums, Gardens, and Galleries," this tract included among other items a number of announcements from the great London museums. One was of particular interest as it noted the appointment of J.H. Leonard, B.Sc., "to conduct parties of Visitors round the Collections," adding that "NO CHARGE is made for this service and no gratuities are to be offered." Mr. Leonard appeared at the museum at noon and at 3:00 P.M., six days a week, with a demanding program that covered as many as seventeen galleries, pavilions, and corridors. Furthermore, special groups could obtain Mr. Leonard's services at other hours, again without charge or gratuity. Leonard and his successors served as guides, philosophers, and often friends to the many individuals who followed them through the museum, week after week, year after year. The museum inspired many people, and for some the tours became a way of life.

In 1931, the Natural History Museum celebrated its first fifty years. By then, museum visitors wanted souvenirs, so new guides were produced. During this period, such figures as King George and Queen Mary; King Alfonso of Spain; Field Marshall Jan Christian Smuts, prime minister of South Africa; and many others visited the museum, and the Staff Association gave monthly tea parties.

At the time of its fiftieth anniversary, the museum addressed itself to matters referred to in a four-page report by the Royal Commission on National Museums and Galleries. The report concluded that the museum needed more staff, better accommodations, and money to play a more active part in expeditions abroad.

Also at this time, under director Tate Regan, an ichthyologist, the museum put together *A Short History of the Collections*, a review of its collections and the departments that contained them. The studies required for this undertaking revealed that through the years some items in the museum's collections had been lost forever. For example, little that was truly ancient in the mammal collection could be identified, two exceptions being the still intact forehead of a West African dwarf buffalo first described in a scientific publication in 1686, and the skeleton of a young chimpanzee described in 1699.

The next decade was a troubled one for the world and the museum. During the Second World War, the museum was struck by bombs many times, suffering fire and water damage. Yet some of the more important specimens, such as an *Archaeopteryx* fossil, fared better, sandbagged and cellared in South Kensington, than those that had been transferred to the cold and damp of stately homes and abandoned slate mines.

The postwar years saw an expansion and reorganization of the staff along civil service lines. Publications began to flow again, and in time galleries were restored and reshaped. In the last decade, several structural changes have been made, including the much-needed addition of a new paleontological wing at the east end of the museum. The whole concept of the museum has been altered, largely by those within the institution. It remains a great source of scientific knowledge through collecting, research, and publication, but it now welcomes the public as never before, with new and imaginative exhibits, accompanied by books that enlarge on the ideas presented. The past three years alone have seen the opening of four exhibits: Human Biology, Introducing Ecology, Dinosaurs and Their Living Relatives, and Man's Place in Evolution. And one of the main events in this year's centenary celebrations will be the opening of yet another, Origin of Species. All of these new exhibits incorporate contemporary visual and mechanical aids, including computers, to emphasize more effectively the diversity of the natural world and the underlying principles of biology.



Alfred Waterhouse
The Granger Collection

This guelder-rose, or snowball (Viburnum opulus), *is part of a collection of dried, pressed specimens made by the young Linnaeus when he was curator of the garden of Dutch merchant George Clifford.*

Old and gray, like many of its friends at home and abroad, what memories the Natural History Museum evokes. The list of distinguished scientists who have walked its galleries is long: Teilhard de Chardin, French paleontologist and philosopher; Robert Broom, anthropological wizard of South Africa; the Leakeys, always bursting with enthusiasm over new and newer finds of the remains of early apes and humans in East Africa; Henry Fairfield Osborn, curator of vertebrate paleontology and president (1908–35) of the American Museum of Natural History; George Gaylord Simpson, evolutionist and paleontologist; and hosts of other friends who came from museums of renown around the world and found themselves much at home in the Cromwell Road.

Returning from expeditions to Africa, India, Madagascar, Australia, the Arctic, and Antarctica, travelers can sometimes catch, as their planes are on the approach to London Airport early in the morning, a glimpse of the museum's arched roofs, shining tiles, and pointed towers, all set in the sunken garden of the Cromwell Road. They can sigh with relief: It is still there, and they are home. Long may the museum remain a home for the traveler whose name is renowned, a place of resort for the thousands who have yet to make their scientific name, and a place of wonder for all. □



2.

The Acadians of Belle-Ile-en-Mer

Exiled from bountiful lands in Canada, these eighteenth-century refugees with New World notions reluctantly settled on a rocky French island

by Naomi E.S. Griffiths

photographs by Henri Bancaud

The inhabitants of Belle-Ile-en-Mer trace their ancestry, in part, to settlers from what is now Nova Scotia and New Brunswick.



New York Public Library

Belle-Ile-en-Mer lies in the Bay of Biscay, some fifteen miles off the southern coast of Brittany. Seven miles long and five and one-half miles across at its widest point, the island runs from northwest to southeast across the Gulf of Morbihan, acting to protect the mainland port of Quiberon. Its wind-swept cliffs, sheltered harbors, and scattered sandy bays, all free of industrial development, have made Belle-Ile a tourist attraction. But there is more to the island than the wild beauty of Apothecary's Cave and the tranquillity of the fishing hamlet of Locmaria. There is also a complex history.

For centuries Belle-Ile was a haven for pirates. Over many decades, from about 1650 to 1760, both the Dutch and the English—depending on the state of international affairs—fought to possess the island in order to obtain a naval base on the very doorstep of France. And, at a more human level, Belle-Ile provided a home for a group of colonists exiled in 1755 from their lands in the New World. These exiles came from Acadia—now mainly the Canadian provinces of Nova Scotia and New Brunswick—where the imperial ambitions of France and England met. Although this settlement of refugees on Belle-Ile did not flourish as its sponsors hoped, it left an enduring heritage for the islanders and marks an extraordinary episode in the story of a resilient and independent people: the Acadians.

International treaties of the





seventeenth and eighteenth centuries gave the name "Acadie or Nova Scotia" to the disputed territory lying between New England and New France. Most of the Europeans who came to settle there were French, but there were also a number with English, Scottish, or Irish heritage. Between 1604 and 1713, the colony changed hands fourteen times, being claimed now by France, now by England, and once by the Netherlands. The people who lived in Acadia developed their own distinctive form of French, but English was known, and the colony had close enough trade relations with Massachusetts to consider Boston to be "our friend, the enemy."

During the eighteenth century, the Acadian lands were seen as increasingly important by both the English and the French. In 1713 the Treaty of Utrecht made the majority of the Acadians the French-speaking, Catholic subjects of the Protestant English crown. The next forty years of strife saw the Acadians attempt to pursue a policy of neutrality, but to no avail: the French believed the Acadians ought to have a fundamental loyalty to France, and the English suspected that they might. Although by the mid-eighteenth century the Acadians were an independent-minded group that scorned the schemes of empires, in 1755 the English decided to evacuate them as a security measure. The governor of the territory attempted to deport the entire population, sending more than 10,000 persons to other English colonies in the New World. Only a few thousand Acadians, including those who were still in French-controlled territory, escaped this deportation, an event the Acadians still call *le grand dérangement*.

For some of the Acadians, the deportation led back to the Old World, and by the conclusion of hostilities in 1763, some three to four thousand were established in the Atlantic ports of France as dependent refugees. These included approximately nine hundred persons who had had the misfortune of being dispatched to Virginia. The governor of that colony had refused to accept them, choosing instead to export them to England, where they had languished in detention camps as charges of the "Sick and Hurt Board" of the Admiralty. It was not until 1763, as part of the treaties ending the Seven Years' War, that these families, among others, were shipped to France to join the refugees already there.

Also under the treaties of 1763, the inhabitants and lands of Belle-Ile-en-Mer reverted to France, after having been in English hands for three years. The French quickly saw Belle-Ile as a place where some of the Acadian refugees might be resettled and returned to a productive, normal life. But the leaders of the Acadian exiles were bluntly unenthusiastic about this proposal. To a group that had suffered one deportation because their lands had become a battleground, the outstanding feature of Belle-Ile was its exposed position.



In a letter to the duc d'Aiguillon, one of the French officials concerned with their resettlement, the Acadians complained that "Belle-Ile is evidently more exposed to enemy attack than any other place in the realm, and in all probability we would find ourselves [there] in a similar situation to the one that has placed us today in such painful straits."

The vulnerability of Belle-Ile was by no means the sole reason for the Acadians' hesitation over the project. Very much North Americans, they saw little to sustain them on the wind-swept, nearly treeless island. As one French lawyer observed, the Acadians had lived in a country of abundance, with plentiful land and soil of infinitely better quality than that of Brittany. Although they knew how to fish, they were accustomed to consuming bread and milk and had contempt for a diet whose staples were fish and cider. They were accustomed to wood, not stone; forests, not quarries. The Acadians themselves wrote to the French officials to point out that given their almost total lack of experience with stone, they would need instruction and help from master stonemasons.

In addition, the Acadians feared that resettlement on Belle-Ile would do further damage to their already disrupted family ties. The deportation of 1755 had split apart a closely knit community of more than 10,000 people, and the majority of the exiles remained outside Europe, either in North America or the

Today, tourists are lured by the rustic charms of Belle-Ile, but the Acadians, deported from their homeland because of international conflicts, were reluctant to settle there. They felt that the island was vulnerable to attack, isolated from overseas communication, and deficient in resources.

Caribbean. The three or four hundred Acadian families that had reached France by 1763 were living in the seaports—the best places for gathering information about other refugees. In particular, the Acadians living in Saint-Malo and Morlaix enjoyed the charity of the duc de Nivernois, who was helpful in reuniting families separated over the previous eight years. Relinquishing such aid and leaving for regions not nearly so well placed for obtaining news from oceangoing vessels was a matter of considerable concern.

To understand how grave this issue was for the Acadians, it should be noted that in the New World, the Acadians had enjoyed a high birth rate and a low death rate, mainly due to their plentiful food supply and to the absence of most of the major epidemic diseases. As the North American colony grew, each village in it came to be joined to all the others by a web of marriages. By 1755 the descendants of a small number of original settlers were linked by extensive family relationships. The deportation, although it rarely separated husbands from wives or young children from their parents, broke apart these large extended families, separating older and younger generations and, above all, brothers and sisters. Records show that throughout their exile the Acadians searched relentlessly for their kin, gathering weeping on such occasions as the death of René Leblanc in Philadelphia, with only 16 of his 102 children and grandchildren

For centuries, the residents of Belle-Ile have made their living from both the land and the sea. The Acadians, accustomed to an abundance of bread and milk, were said to be contemptuous of the local diet, whose staples were fish and cider.



at his deathbed. The documents left by the heads of two families that finally settled on Belle-Ile showed a typical pattern: Michel Boudrot had a brother and sister-in-law in New York and another brother in New Orleans; Claude Dion was separated from ten brothers and sisters, who were distributed in Halifax, Boston, Plymouth, and New York, with only one in France, near Saint-Malo.

Like the Acadians, the natives of Belle-Ile's four parishes were ambivalent about the proposed resettlement. During this period the official directly responsible for the administration of Belle-Ile was Baron de Warren, a Scotsman who had been exiled after leading the last fruitless charge against Carlisle for Bonnie Prince Charlie. Although de Warren was filled with "eagerness and longing" to see the Acadians settled on the island, he quickly learned of opposition to the plan among the inhabitants of the parishes on the island—an attitude that had been fostered by the largest and most important parish, Le Palais. Local officials informed the baron in a letter of March 30, 1763, that the smaller parishes, "seduced by the bad example of Le Palais, have haughtily declared to Messieurs the officials that they do not wish to give up their villages to strangers." De Warren was further hampered by a continual and acerbic argument between officials at every level of authority—local, provincial, departmental, and royal—as to which budget should assume the costs of carrying out the projected settlement.

That some of the Acadians were finally settled on Belle-Ile was due in great measure to the persistence of the abbé Le Loutre, a missionary priest who had worked among the American Indians. Le Loutre, concerned with saving Acadian souls from the Protestant English, had actually helped to provoke the deportation whose ill-effects he now sought to alleviate. Once back in France, however, his concern turned to preserving the Acadian heritage from corruption by what he regarded as decadent French Catholicism. It was above all owing to the energies of this man, whom de Warren called the "grand mufti" of the Acadians, first, that in April of 1764 Louis XV paid the monies (56,000 livres) that the



crown had promised the Acadians as aid, and second, that the Acadians who went to Belle-Ile were granted exemption from all taxes for the first five years of the settlement. And it was through Le Loutre's efforts that in the fall of 1765 seventy-eight Acadian families were persuaded to set out to begin a new life on Belle-Ile. In a letter dated November 2, 1765, de Warren was able to write of the success of the venture, although, as he recounted, the last two boatloads of refugees, arriving from Morlaix, had to be rescued. The first boat had actually sunk, and the second had drifted dangerously close to the rocks at the harbor's edge. Fortunately, there had been no loss of life.

The Acadians were divided up among the four parishes of the island: twelve families went to Le Palais, north of the center of the island; thirty went to Bangor, to the south; twelve went to Locmaria, at the eastern end of the island; and twenty-four went to Sauzon, the parish at the western tip that later became Sarah Bernhardt's favorite summer retreat. As had been agreed, Louis XV paid each family for the building of a house; provided each with a horse, a cow, and various other livestock; and made available to the families of each parish a bull and a stallion. Further, so that the Acadians might begin life on Belle-Ile under the best possible circumstances, on their arrival each Acadian family was given three months' rations. One hundred ten pounds of tobacco was also delivered monthly for the Acadians' use.

The refugees were placed on Belle-Ile according to the personal plan of de Warren, who in correspondence with the abbé Le Loutre argued the question of how the Acadians should be organized. The abbé felt that, above all, the Acadians should be allowed to live as they had always lived, not mixed up with the *bellilois*, but as neighbors in a homogeneous community. The governor, however, replied that he found it "to the benefit of the service of the King and the interest of the provinces to distribute [the Acadians] equally in the four parishes on the island," pointing out that the refugees would "profit from both the advantages and disadvantages that each parish has." De Warren believed that only in this way would it be possible to establish "that unity and good harmony that must exist between the new settlers and the old, so that all come together with one spirit and make one people."

In 1765 Belle-Ile's native population was made up of some 375 families who worked the land and another 108 whose lives were more closely linked to the sea. De Warren reasoned that the Acadians would be more easily accepted and would be able to learn the local customs and pick up Breton—the common language on the island—if they were not permitted to retreat to the isolation of separate villages. His plan for the assimilation of the refugees was sensible enough, but before it could be tested any hope of establishing Belle-Ile as a center for Acadians in France was destroyed.

The crippling blows that were dealt the experiment came from both nature and French officials. To begin with, there was the climate. No sooner had the Acadians arrived on Belle-Ile than the island was faced with a drought that was to last six years, a drought of such severity that each year's crops barely yielded enough food for the current year, let alone seed for the next. Moreover, about the same time, the island's animals were struck with foot-and-mouth disease. The very basis of the new life was destroyed. Then came a major piece of bureaucratic bungling. In 1768 the office of the French comptroller-general demanded





payment from the Acadians of taxes that, according to the 1765 agreements, were not to have been due for more than a year. By the end of July 1768, Le Loutre was writing in despair to de Warren, predicting the failure of the scheme and already mourning the loss to France of "such good farmers."

There was, in fact, a deep conflict between the social expectations of the Acadians and the ideas of the *ancien régime*, the policies then forming a structured and rigidly codified French society. Perhaps more than anything else, it was this difficulty that led, almost inexorably, first, to the withering of a distinctive Acadian settlement on Belle-Ile and finally, in 1785, to the departure from France of almost all of the Acadians who had settled there. The story of the conflict can be read in much detail in legal records, and it is told, in part, with the vocabulary of *la capitation, la vingtième, les gargennes de fouage, la dixième*—all taxes with which the Acadians were eventually confronted. Although such taxes were a familiar burden to French peasants, they did not sit well with the Acadians, who even before they became untaxed refugees had paid no tax more onerous than the nominal penny-a-year quitrent required by the English. As colonists in North America, the Acadians had been immune to the threat of higher taxes, aware as they were of land reasonably close by but beyond the administrative reach of the official seats of government.

The majority of the 400 Acadians who settled on Belle-Ile in 1765 left within a few years, discouraged by natural calamities and by the burdens of French rule. Those who remained, however, were absorbed into the island's population, becoming bellilois.



The Acadians who settled on Belle-Ile were at least able to negotiate a temporary exemption from the French taxes, but they suffered a variety of other unfamiliar constraints. There were restrictions on hunting, on fishing, on moving about without passports. French court records of the time report the prosecution of Acadians found in ports and cities other than those to which they had been assigned and without the documents of identification that the French officials wished them to carry. Even the stiff official prose of the records cannot disguise the challenge that these second-, third-, and in some cases, fourth-generation North Americans made to the conventions of the France of Louis XV and Madame de Pompadour.

By 1772 three-quarters of the more than four hundred Acadians who had come to settle on Belle-Ile had left the island. Homeless once again, they tended to follow one of three routes. Some continued to wander, searching for a secure home in the Falklands, Santo Domingo, or Corsica, but all of their efforts failed to establish a central community for the refugees. A number of the Acadian families from Belle-Ile settled in other parts of France, slowly becoming absorbed in the life of the villages where their fortunes had led them: their descendants would be French, having perhaps a more romantic past than most of their neighbors. But the route by far most traveled by the newly displaced Acadians led back to the New World.



The Acadian heritage of Belle-Ile links the island's people to surviving Acadian communities in Canada and to the related Cajun population of Louisiana. In recent years, friendships have been established across the Atlantic as Acadians have traced their genealogical ties.

In 1783 a group of Acadian refugees living in the ports of Brittany sent a petition to Louis XVI, which read in part: "After twenty-eight years, after the loss of our property, we find ourselves in poverty and misery. The landlords daily refuse to house us, and without His Majesty's pay we cannot live. We are grieved that we are a burden." At this point, circumstances brought forward a sympathetic Frenchman, Peyroux de la Coudrenière. Peyroux had spent seven years in Louisiana, which was still a Spanish colony, and he had met the few Acadians who had settled there after passing through the British possessions in North America. He suggested that the Acadians remaining in France could also prove useful in Louisiana, a place where they might be much happier.

With considerable effort, Peyroux convinced the Acadians, the French officials, and the representatives of the Spanish government to adopt his plan. In need of settlers, the Spanish government agreed not only to pay the Acadians' transportation costs but also to subsidize them during the early years of their resettlement. Finally, in 1785, seven "Acadian expeditions" set sail from Nantes for New Orleans to join those Acadian refugees who had already settled in the parishes of Saint-Landry des Openousas, Saint-Gabriel d'Iberville, Saint-Louis de la Nouvelle-Orléans, and Saint-Martin des Atakapas. About 2,000 Acadians landed in Louisiana, and it is largely from this group that the distinctive Cajun population found there today developed. Although other immigrants also helped to form this people, the name "Cajun" emphasizes this Acadian origin.

The minority of Acadian families that remained on Belle-Ile after 1772, despite the initial setbacks, succeeded in adapting to the new life, eventually becoming *bellilois*. A census of the Acadians of Belle-Ile taken during the French Revolution identified 285 Acadians, 197 of whom had been born on the island. René Daligaut, the local antiquarian who in 1964 established a newsletter about the history of Belle-Ile, is convinced that there is no island family today that cannot claim an Acadian ancestor.

Today the Acadian communities of the Maritime Provinces of Canada, as well as the Cajun population of Louisiana, show an ever growing interest in the history of Belle-Ile-en-Mer. During the last thirty years delegations have crossed the Atlantic in both directions as Acadians have sought to trace genealogies and to establish friendly relations. The legacy of the Acadian refugees remains sufficiently vibrant for Belle-Ile-en-Mer to have held a festival celebrating the bicentennial of their arrival. Their sojourn is commemorated by a bronze plaque affixed to the archway of the town gate of Le Palais. And in the cemetery of Sauzon, weathered, lopsided headstones bring the names of Nova Scotia and New Brunswick to the eye. □







Olympic Mountain Goats

Introduced into the Olympic Mountains, these nimble animals have done so well that they are endangering plants that a national park is supposed to protect

by Michael Hutchins and Victoria Stevens

At home among wind-worn rocks and alpine meadows lying at or above timberline, mountain goats have adapted to an environment that is inhospitable by human standards. In the mountains, they have gained at least a temporary reprieve from the destructive byproducts of civilization—the pollution, urban expansion, and environmental deterioration that have pushed many lowland species to the brink of extinction. High above the clouds they can seem distant and removed—white shadows in a mountain mist.

The mountain goat (*Oreamnos americanus*) is not a true goat, but a goat-antelope. The only living member of its genus, its closest relatives are the mountain-dwelling antelopes of the Old World, including the chamois of Europe and the goral, takin, and serow of Asia. The species' natural range extends from Alaska to Idaho, Montana, and Washington in the United States, and includes Alberta, British Columbia, and the Northwest and Yukon Territories in Canada.

One of the best areas for observing these remarkable herbivores is in Olympic National Park, located on the Olympic Peninsula in northwestern Washington state. In the rugged Olympic Mountains they seem to epitomize the beauty of nature, and they are extremely popular with visitors to the 1,400-square-mile wilderness preserve. Appearances, however, can be deceiving. At present, the animals are the cause of considerable concern to park managers and conservationists. The problem is that mountain goats are not native to the Olympic Peninsula. Introduced to the region purposely, they may be causing significant changes in the natural ecosystem.

Mountain goats were introduced to the Olympic Mountains between 1925 and 1929, through the combined efforts of Washington state wildlife agents, the U.S. Forest Service, and a local sportsman's club. Records of the number of animals involved in the transplants are sketchy, but apparently eleven or twelve were released near Lake Crescent in the north-central portion of the peninsula. The animals came from Alaska and the Canadian Rocky Mountains near Banff, Alberta.

Why mountain goats were brought to the Olympic Mountains is not a matter of record, but since they have long been prized as trophy animals, the potential for establishing a harvestable population probably provided some incentive. At the time, the region was administered by the Forest Service, which has traditionally allowed recreational hunting on its lands. Long before the animals became numerous enough to hunt, however, much of the peninsula fell under the jurisdiction of the National Park Service. In 1933 control was transferred to the Department of the Interior, and in 1938 the area became Olympic National Park. Protected by federal law, the introduced goats proliferated, and current estimates suggest that as many as 700 may inhabit the region today.

The absence of native goat populations in the Olympic Mountains poses an interesting biogeographical question, particularly since the habitat is ideally suited to these animals and since they are native to the Cascade Range less than 100 miles to the east. A knowledge of the region's geologic history is essential to an understanding of the evolution and distribution of its flora and fauna and, ultimately, of the problems associated with the introduced mountain goats.

Keith Gunner



Tom and Pat Leeson



Left: Two goats rest atop Hurricane Hill during the heat of a summer afternoon. Such ridges afford the goats a view of possible predators approaching from below, while cooling breezes help them to regulate their body temperature. Above: Roughly three days old, a kid trails its mother while she feeds on a precipitous slope. Kids are highly precocious and can walk a few hours after birth. The nanny is shedding her coat of hair, as all mountain goats begin to do in late spring.

Tom and Pat Leeson

Isolated from other mountain ranges, the Olympic high country is surrounded by the waters of the Pacific Ocean, the Strait of Juan de Fuca, and Puget Sound, and by the lowlands of the Chehalis River Valley. Geologic evidence suggests that between twelve and twenty million years ago a shifting of the earth's crust created a mountain range running east to west across what is now the state of Washington. During this transformation, the regions to the north and south of the present Olympic Range were depressed, forming the Strait of Juan de Fuca and the Chehalis River Valley. A second event that occurred about five million years ago completed the isolation. At this time, the Olympics were elevated further, the Cascades were formed, and a concurrent down-folding of the area lying between the two ranges formed the Puget Sound Trough. During this critical period the subtle divergence of the Olympic ecosystem began.

Little is known about the evolution of mountain goats or the history of their dispersal, but it would appear that the events that isolated the Olympic Mountains had already taken place when the animals colonized the North American continent. Paleontologists have suggested that ancestral goats evolved in Asia and entered North America over the Bering land bridge that existed at various times in the geologic past. The skeletal remains of Pleistocene mountain goats, including those of a smaller, extinct species (*Oreamnos haringtoni*), have been found in eight separate localities ranging from the Yukon Territory to Mexico. The oldest-known remains come from British Columbia and date from the Sangamon Interglacial period, some 140,000 years ago.

Because of their isolation, the Olympic Mountains were not easily accessible to mountain goats or other Old World colonizers. The long-term isolation of the region is reflected in the presence and often abundance in the Cascades of at least seven other mammals that are not found in the Olympics. These include the pika, a small relative of the rabbits and hares; the Cascades red fox; and the Cascades golden-mantled ground squirrel.

Geographical isolation has also resulted in the evolution of animals that are endemic, or unique, to the Olympic Mountains. Not surprisingly, these are alpine species, since the alpine areas of the peninsula are effectively islands in a lowland sea. Prominent among these endemics is the Olympic marmot, a large colonially living rodent. Perhaps less noticeable, but no less unique, are twelve species and varieties of endemic alpine plants. Species unique to the Olympic Mountains include Cotton's milkvetch, Piper's bellflower, Flett violet, Flett fleabane, Webster's senecio, and rock spirea. The remainder are geographically distinct varieties of species that are also found in the Cascades, such as the mountain wallflower (*Erysimum arenicola* var. *arenicola*) and the Olympic rockcress (*Arabis furcata* var. *olympica*).

There is growing concern about the future of the delicately flowered alpine plants, particularly since their range overlaps that of the introduced

mountain goat. Apprehension about the potential effect of mountain goats on endemic plants and other organisms in the ecological community stems from the knowledge that alpine environments are among the most fragile of ecosystems, characterized by short growing seasons, low plant productivity, shallow soils, and harsh environmental conditions. These conditions, which include high winds, low soil moisture, and frequent freezing and thawing, combine with slow rates of plant growth to make alpine ecosystems such as those found in the Olympics particularly sensitive to disturbance. The common belief is that the most significant impact of herbivores on plant communities results from their feeding on vegetation, but in an alpine environment, trampling and digging may be far more deleterious.

Since 1976 we have been studying the ecology and behavior of mountain goats in Olympic National Park with a twofold purpose: Besides seeking to increase our knowledge of the biology of this species, we hope to aid the National Park Service in developing a plan for managing the animals.

We conduct intensive field research from May through September, since inclement weather and the threat of avalanches make winter observations difficult. Much of our work has been done in a five-square-mile area in the northeastern portion of the park. Lying at an elevation of about 6,000 feet, this rugged terrain is the most densely populated on the peninsula, inhabited by as many as 165 mountain goats. Thus far, more than 100 of these have been marked with numbered ear tags for individual identification, and by following and observing known individuals, we have documented many aspects of mountain goat ecology and behavior in greater detail than was previously possible.

Superbly adapted for life in the mountains, the goats exhibit a distinct preference for rocky habitats, a trait

A mountain goat cools off by flinging soil over its body. The soil also provides some protection from insects. Erosion results wherever the goats create wallows for dust bathing.



Keith Gunner, Bruce Colemen, Inc.

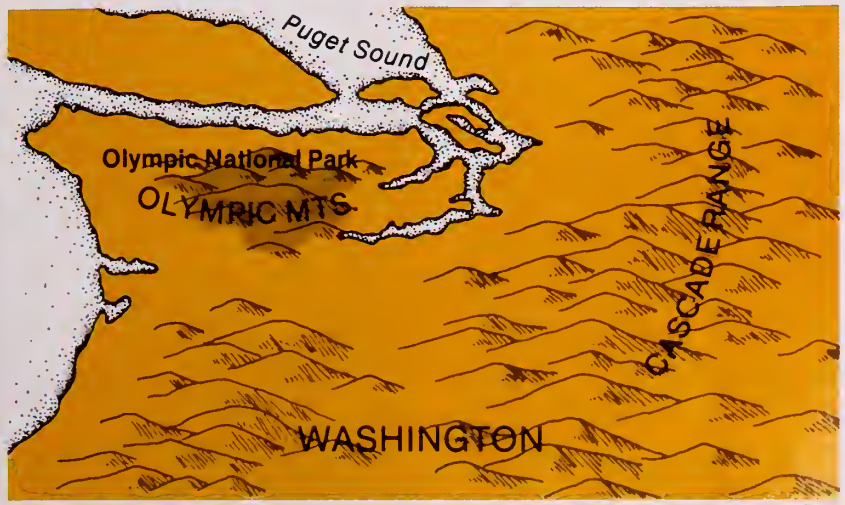
that may have evolved as a means of escaping predators. Goats bed on or near rock outcroppings and kids are generally born in the protection of rocky cover. Although we have found little solid evidence of predation on goats in the Olympic Mountains, the region is frequented by cougars, bobcats, coyotes, and golden eagles; all have been known to prey on mountain goats in other settings. Only the cougar, however, is formidable enough to attack and kill an adult goat. Another major predator, the wolf, has been extinct on the Olympic Peninsula for nearly fifty years.

As is well known, mountain goats are accomplished climbers, their hoofs allowing them greater mobility on rugged, precipitous terrain than that attained by most other North American ungulates. Mountain goats are artiodactyls, or even-toed ungulates, having two toes on each foot. The outer edges of each toe are composed of a hard, bony shell that encircles a softer inner part. Unlike deer or elk, whose inner foot parts are concave, the mountain goat's inner foot is convex—an adaptation that provides for improved traction on smooth rock surfaces and more efficient use of small footholds in climbing. Vertical cliffs and rocky bluffs are an important aspect of the mountain goat's ecology not only because they provide a safe haven from predators but also because they offer freedom from deep snow and access to forage that is beyond the reach of other ungulates.



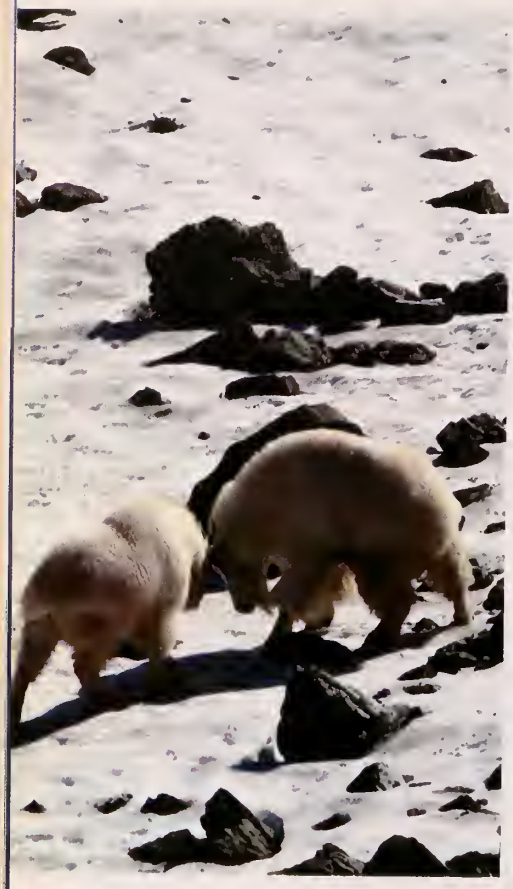
Another essential feature of the mountain goat's habitat is the alpine meadows, dense patches of grasses and herbaceous plants, which provide the animal's major food resource. Mountain goats are generalists and will utilize nearly all available plant species. Like most animals inhabiting temperate regions, mountain goats must cope with seasonal fluctuations in food availability. The plant communities on which they subsist are composed primarily of perennials, which maintain vegetative parts such as leaves, stems, and flowers above ground for only a short time each year. During the winter most alpine plants are dormant, saving their energy for more favorable weather in the spring. This dormancy coincides with a time when major portions of the vegetational habitat are covered with deep snow, making them inaccessible to hungry herbivores. In some regions, mountain goats may exhibit vertical migration, moving down to lower altitudes where there is less snow and food is more readily obtainable. During the summer, when food is abundant, the animals consume quantities in excess of their daily needs. Their indulgent eating habits result in an accumulation of fat, which helps to sustain them during the lean winter months. Since 1976, nine mountain goats have been found dead in the park. Most mortality is apparently the result—direct or indirect—of winter malnutrition. Several of the dead goats were killed by accidental falls, which are more likely if an animal is in a weakened condition.

Like most artiodactyls, mountain goats are ruminants: ungulates with a four-chambered stomach. The first and largest of these chambers, the rumen, contains colonies of bacteria and protozoans specialized for breaking down carbohydrates and cellulose—the major constituent of the cell walls of plants. Since ruminants lack some necessary enzymes, they rely on "hitchhiking" microorganisms to aid them in digestion. Through a complex fermentation process, these symbionts manufacture essential amino acids, synthesize water-soluble vitamins, and convert cellulose into volatile fatty acids. The latter are absorbed directly through the rumen and are an important source of energy. The microorganisms themselves are digested as they pass through the intestines and provide the ruminant with protein needed for bodily growth and maintenance. In addition, the rumen serves as a holding tank for unchewed food eaten quickly during limited foraging

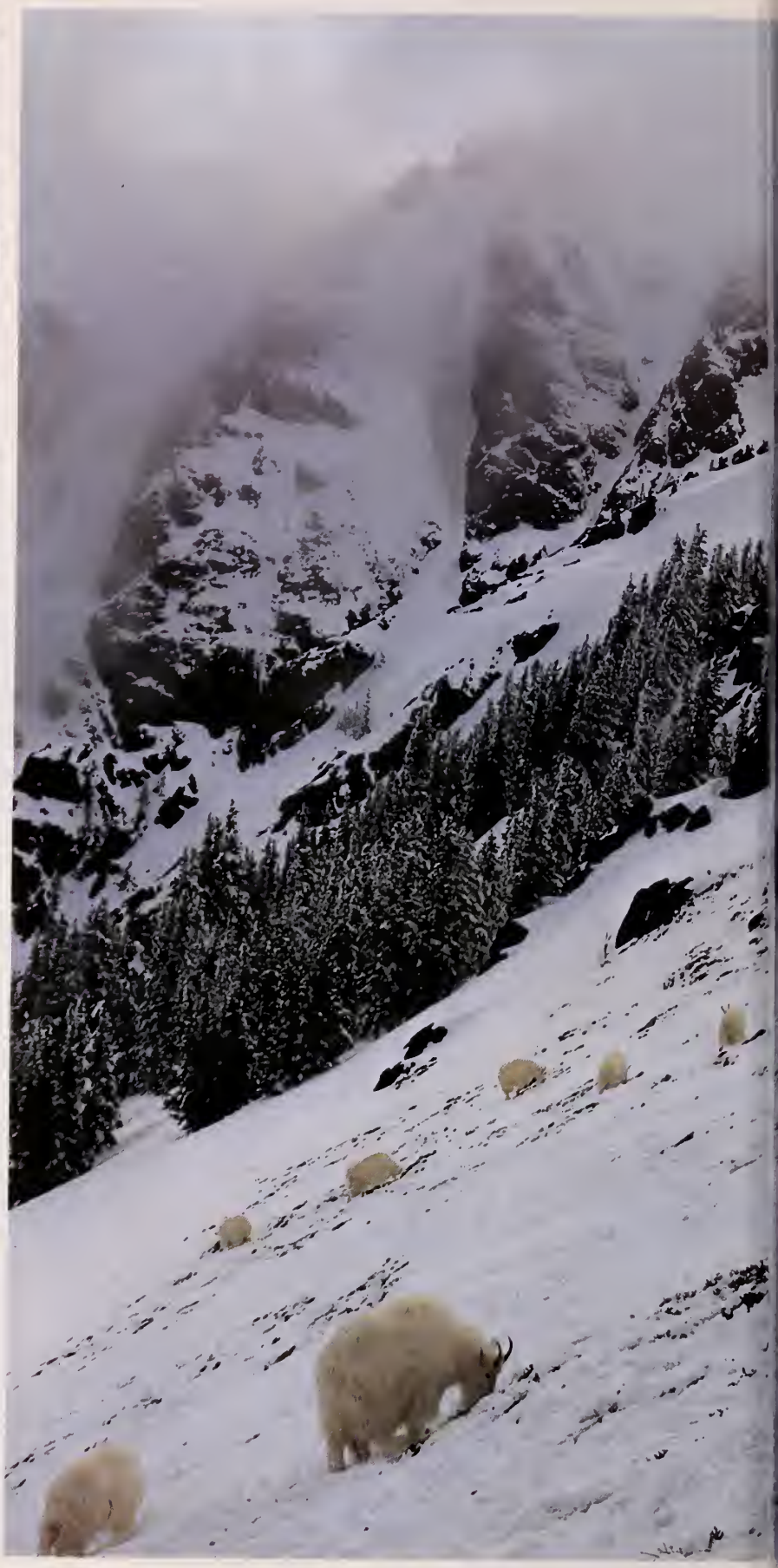


Joe Le Monnier

Tom and Pat Leeson



Swiping horns, two males contest the spot on which the smaller one had been lying, above. The larger male, which was dominant, won the spot from his subordinate after a few harmless swipes. Males engage in such competitive behavior throughout the year, but with the approach of the breeding season the seriousness of the bouts escalates. The goats' sharp horns can inflict heavy damage to an opponent, and the loser of a bout can be killed. In general, dominant males do most of the breeding. Some subordinate males may not breed at all. On Mount Angeles, right, mountain goats forage through the winter snows. If the snow cover is heavy, the goats will move below the 6,000-foot elevation in search of food.



Keith Gunnar



periods. Such food can be regurgitated and chewed while the animal is at rest, as in the familiar cud chewing of domestic cows. The primary advantage of the rumen is that it allows an animal to subsist on relatively low-quality food by increasing the efficiency of the digestive system.

Mineral licks are another important aspect of the mountain goat's ecology. The animals have a craving for salt, which seems to peak in late spring and early summer. This peak coincides with the time in which they are making a transition from low-quality winter forage to newly emergent vegetation. Physiological studies have shown that an ungulate's ability to retain sodium—an element necessary for many bodily functions—is influenced by diet. Ingestion of newly emergent and highly succulent vegetation increases the loss of sodium in the feces, and the animals may compensate for this deficiency by consuming the substance directly. More recently, however, studies of the chemical composition of natural mineral licks suggest that sodium may be a relatively rare element, and that ungulates may actually be seeking inorganic sulfur in the form of sulfates. These substances are converted in the ruminant's digestive system into amino acids, such as cystine, which are essential for hair growth and lactation.

There are no natural mineral licks in the Olympic Mountains that are known to be used by goats, but the remains of a large artificial salt lick still exist. National Park Service officials stopped providing salt for goats several years ago when they noticed that excessive trampling in the area of the lick was resulting in habitat destruction. The area is now almost completely devoid of vegetation, but the animals still use the lick extensively, apparently seeking minerals that have percolated into the soil. (Hikers sometimes unwittingly increase such deterioration by pausing to relieve themselves by the trail. Human urine has a salty taste and is very attractive to mineral-starved goats. The trampling, digging, and licking by animals at these sites can be a factor contributing to erosion.)

Mountain goat summer range must also provide a variety of microhabitats that aid the animals in thermoregulation. During the course of a year, mountain goats are subjected to extremes of both hot and cold, and their body temperature is regulated through physiological and behavioral means. The goats' long, dense fur, which helps to reduce heat loss during the winter, is shed during the summer when temperatures may soar over 90°F. Ruminants are particularly susceptible to overheating since their digestive system has a built-in "furnace." The colonies of microorganisms, which break down cellulose, generate heat as a result of their own metabolic processes. This heat, combined with a goat's own heat and with solar radiation absorbed from the environment, can result in thermal stress if there is no compensating movement into a cooler microhabitat. On a hot day, the animals typically seek shade or recline on patches of snow. When overheated or harassed by insects, a goat may also lie in dirt and, with a quick movement of a foreleg, throw cool soil over its body. This behavior is a further cause of erosion, resulting in the creation of wallows, large patches of exposed soil used regularly for dust bathing. Once the soil surface has been disturbed in this manner, erosion is initiated and can be expected to continue even in the absence of goat use.

The white coat of the mountain goat may also function in thermoregulation. The white color might be a form of protective coloration and, in fact, predators may find the goats more difficult to see when the mountains are hidden by a veil of snow. Such an advantage does not extend into the summer, however, when snowfields melt and alpine meadows fill with lush green vegetation. The traditional view is that in this season the white coat may act to reflect solar radiation and so keep the goats cool; but recent physiological studies have also shown that in a windy environment, such as the mountains in winter, more heat is absorbed by a light coat than by a dark one.

Many areas of the Olympic Mountains possess the essential components of the mountain goat's habitat. The distribution of such favorable ecological characteristics has influenced the population growth of these introduced herbivores and their pattern of distribution. Parkwide surveys have confirmed that the animals now inhabit nearly all of the region's suitable habitat, and birth and dispersal rates suggest that the population is still expanding.

Since 1977, 20 percent of the animals tagged in the high-density study

Michael Hutchins





Flett violet, above, is one of the alpine plants threatened by the grazing and trampling of the goats. Convex inner foot parts enable the two kids to gambol on the face of a rock wall, right.

site have moved to other parts of the peninsula. Such movement has not been observed from areas of lower density. Most long-distance travelers have been young males, but some adult females with kids have left the crowded conditions and moved as far as fifty miles away. Adult females usually exhibit a strong affinity for a particular home range, never moving more than six miles in any direction. The dangers associated with leaving familiar territory are considerable. Dispersing animals move into environments where they have no knowledge of the location of food or other essential resources. On the other hand, young males are often excluded from breeding by older, more dominant individuals and therefore may benefit by seeking a less competitive social environment. Adult female goats do not compete for mates, but competition for resources might be expected to influence their behavior. As a result of the movement of adult females out of the high-density study area, some of the smaller outlying populations have grown significantly in the past two years. Without exception, females in these less crowded areas have a higher birth rate than those in the high-density site.

The social life of mountain goats is as fascinating as their ecology and demography, and the Olympic Mountains provide an ideal laboratory for detailed behavioral study. The marking of many animals for individual recognition has greatly facilitated our work. In the past, few long-term studies have been conducted on mountain goat behavior. Indeed, one authoritative book on mammals still incorrectly describes the species' mating system as monogamous. Actually they are polygynous: a dominant male may mate with several females and some subordinate males may not mate at all. During the rut, in late November and early December, the competition for access to estrous females may be intense. Males threaten each other by hunching their backs, presenting their broadsides, and swiping upward with their horns while circling around each other head to tail. They may also sit next to each other and paw the ground repeatedly with one foreleg. Their digging results in the formation of the so-called rutting pits.

Similarities in the appearance of the sexes has probably contributed to the monogamy myth. Although adult males may weigh up to 250 pounds and are on average 30 percent heavier than females, both sexes possess true horns, which continue to grow throughout an individual's lifetime. The horns are dagger sharp, and although they are often used only to threaten other goats, fights occasionally become more serious. Males may carry the scars of many battles and have been known to kill each other while fighting over a female.

During the summer months, adult females, juveniles of both sexes, and kids congregate in nursery bands. These are loose aggregations that include anywhere from two to more than fifty individuals. Adult males and females seldom interact with each other outside the rut, except when both sexes use the salt lick in late spring. During the summer, males may be solitary or travel in small groups of two or three. A similar pattern is seen in bighorn sheep, and some behaviorists have speculated that this spatial segregation may reduce competition between males and their offspring. The same may be true of mountain goats.

In mountain goat society, females, or "nannies," are highly competitive and intolerant of one another. Although gregarious, they have a well-defined personal space with a radius of about three to six feet. Any intrusion into this space by an individual other than offspring usually results in aggression or avoidance. Some of the patterns of aggression seen among females are similar to those exhibited by males and include broadside displays, as well as lowering and presenting the horns. Aggression among

Tom and Pat Leeson



females is observed most frequently at the salt lick, which is a concentrated, defendable resource.

Our behavioral studies have focused primarily on mother–offspring relationships. Females usually produce a single kid, but twins are also seen on occasion. Born in late May or early June, the kids are highly precocious, being able to stand and walk only a few hours after birth. Mountain goat kids can be classified as followers rather than hiders. More precisely, many ungulates, including deer and elk, deposit their young in a thick patch of vegetation and leave them alone. While their mothers are foraging, the deer fawns and elk calves lie motionless, thereby reducing the possibility of being seen by predators. In contrast, mountain goat kids only a few days old follow their mothers, rarely straying more than a few yards away. In the goats' open alpine habitat, hiding would be difficult.

Nannies are generally intolerant of strange kids and may chase or threaten them if they come too close. Recognition of young seems largely olfactory, and nannies commonly smell their young upon being reunited with them after a brief separation. Mothers and kids may also recognize each other's calls, since voice recognition has been described for other ungulate species, such as reindeer and domestic sheep. The common response of a kid separated from its mother is to run frantically from one female to the next, bleating loudly. Such calls are also given when kids fall several yards behind their mothers during routine foraging or travel. Females may respond to vocalizing kids by calling or by looking for their offspring.

Like other mammalian young, mountain goat kids are nutritionally dependent on mother's milk during the early stages of their development. For a time, mothers may initiate nursing by placing themselves in favorable positions, and permitting the young to nurse until satiated. Some nursing bouts may even be terminated by the offspring. This pattern changes over time, however, and mothers become progressively less willing to allow access to their teats. This weaning process prompts kids to seek nourishment elsewhere, and they begin to forage regularly on vegetation. Female mountain goats begin to reject their offspring's attempts to nurse within the first week of life, using a variety of methods. For example, a mother may step over the offspring and walk away or she may give a quick stamp of her rear leg. Unless their offspring are particularly persistent, females are seldom aggressive in this situation.

Little is known about the breakdown of mother–infant bonds in ungulates. Previous studies have suggested that mountain goat young remain with their mothers for about eleven months, and that this relationship is severed just prior to the birth of a new kid. Some investigators have suggested that severance of mother–infant ties is due primarily to maternal intolerance, whereas others believe that yearlings leave on their own initiative. Our observations suggest that nannies do become intolerant of their yearling just prior to the birth of a new kid, but females that become barren may extend the period of maternal affiliation for up to two years. We observed several cases in which females maintained consistent association with their yearlings or two-year-olds. Such relationships are similar to those seen between mothers and kids and involved relatively frequent, friendly contact.

Retaining offspring may convey a number of advantages. To begin with, reproduction requires energy, and factors such as the quality of available forage and the amount of competition for food resources can be expected to influence a female's ability to produce offspring in any given year. Barren females or those that lose their young to predators, accidents, or disease may be able to increase their older offspring's chances of survival and competitive ability by continuing to associate with them. For example, we have noticed that retained yearlings and two-year-olds share in the relatively higher dominance status of their mothers, particularly at defendable resources such as the salt lick. Young retained by dominant females often utilize the lick at the same time as their mothers, while their less fortunate peers wait on the periphery. Retained offspring also nurse occasionally, although we have not as yet been able to determine whether their mothers continue to produce milk. They nurse far less frequently than kids, and the practice may simply represent the kind of nonnutritive "comfort suckling" seen in many young mammals. The mothers may also gain some immediate advantages from the extended period of association. We



have observed yearlings grooming their mothers, and in one case, a retained offspring paid particular attention to its mother's badly wounded eye. Such aid-giving behavior may help reduce the risk of infection and increase the probability of survival.

Unattached yearlings or two-year-olds, although they are not tolerated in the same way as retained offspring, often attempt to follow adult females. This finding suggests that there may be some advantage to associating with an older individual. For example, young animals may learn the location of prime feeding areas by following adults that have a better knowledge of the home range.

The introduced mountain goats of Olympic National Park represent a difficult and complex problem for the park service. The alpine wilderness of the Olympic Mountains provides an excellent habitat for these animals, and these nonnative herbivores may be altering the composition of plant communities and even endangering some rare endemic varieties.

Botanical studies initiated by Ingrid Olmsted, and expanded by Douglas Pike and William Pfitsch of the University of Washington, suggest that the introduced mountain goats have reduced plant cover, increased erosion, and shifted plant-community dominants toward more resistant or less palatable species. Unfortunately, only a limited amount of information exists about the structure of this plant community prior to the introduction of the goats, but noticeable changes have been observed since these botanical studies began. In addition, mountain goats are known to graze on at least three of the endemic plants. Such grazing results in the removal of a significant number of flowers—the potential source of seed for future generations. If sexual reproduction from flowers is more important than asexual, or vegetative, reproduction in these plants, then overgrazing could ultimately result in a decrease in the size of their populations. The effects of grazing, combined with erosion caused by soil disturbance and with competition from disturbance-adapted plants, could eventually lead to the extinction of some species. Feral domestic goats are known to have eliminated many species of indigenous plants in the Galápagos Islands and other island ecosystems.

Detailed analyses of exclosures—fenced areas built to exclude mountain goats—suggest that the recovery of badly damaged meadows will proceed slowly if at all. Studies by Ed Schreiner of Olympic National Park indicate that similar meadows damaged by as few as 500 passes by human hikers may take up to 100 years to recover. The congressional act of 1916 that established the National Park Service specifies the preservation of natural ecosystems as one of the organization's primary responsibilities. According to a frequently quoted passage, the service's purpose in the lands it controls is to "conserve the scenery and natural and historic objects and wildlife therein and to provide for the enjoyment of the same in such a manner and by such means as will leave them unimpaired for the enjoyment of future generations." To fulfill this obligation, the Olympic mountain goats and, for that matter, all introduced species should be removed or at least carefully controlled on lands under park service jurisdiction. However, practical and political obstacles to such a management plan abound. The political implications are particularly significant, since the National Park Service is a federal agency whose actions are subject to public scrutiny. Ironically, the animals have long been promoted as a tourist attraction and have even been featured on posters advertising Olympic National Park.

The concern over public response to a management plan that would remove introduced animals from federal lands is based on previous experience. Attempts to control feral burros in Grand Canyon National Park have met with serious opposition. Released by prospectors about the turn of the century, the burros successfully adapted to the environment and reproduced prolifically. Indeed, as early as 1924, park managers noticed that the burros' foraging and trampling were having an impact on the canyon's fragile ecosystem. Periodic efforts at controlling the animals, made between 1924 and 1969, resulted in the capture or shooting of nearly 3,000 burros, but complete eradication was never achieved. These attempts at controlling the animals came to a halt when groups began protesting the killings. The dispute eventually led to a court battle, and the issue is still not resolved.

Some wildlife managers have attributed emotional outbursts over the killing of feral burros to a sociological phenomenon termed the Bambi syndrome, after the animated Disney character. Public attitudes about animals and nature have certainly been influenced by anthropomorphic characterizations in books, films, and television. Regardless of the factors responsible for such attitudes, however, there are those who believe that burros have a right to life and that they should be kept in the park for people to enjoy. Still others contend that the animals' continued presence may result in the destruction of a natural ecosystem that took many millenniums to evolve. Once destroyed, such systems cannot be replaced.

Understandably, park service officials must exercise care in their preparation of a mountain goat management plan for Olympic National Park. Research efforts are continuing, and management options will be presented for public review. Not all management options call for destroying the entire population. For instance, it might be possible to restrict the animals to particular areas of the park and carefully control their numbers. Alternatively, it may be possible to capture and transplant at least some of the animals to locations in their natural range. Humane treatment of the animals is an important consideration, and a detailed knowledge of mountain goat ecology and behavior will be essential to the development of management alternatives.

The controversy surrounding the management of introduced species has focused increased attention on some difficult philosophical questions. What is the function of our national park system? And should the park service's primary responsibility be to preserve natural ecosystems in as pristine a state as possible or simply to provide the public with enjoyable places for recreation? As human population growth, urban expansion, and an ever increasing demand for resources reduce our once-abundant natural areas to mere islands of wilderness, questions of this kind will assume considerable importance. □

During the mating season, corneal glands at the base of a male's horns secrete a liquid that stains the lower part of the horns. The secretion may be rubbed on bushes as a means of expressing dominance.

Ted and Pet Leeson

A Voyage in the East China Sea

The first Sino-American oceanographic project in more than thirty years investigates sediment discharge in shallow coastal waters

by John D. Milliman

China, with its rich cultural and political history, has long attracted the interest of the Western world. For a marine geologist, this vast country holds a special fascination since oceanographic features unique to China may be the key to understanding both modern and ancient geologic processes. Now, the expansion of relations between the United States and China is enabling scientists from the two countries to join in exploring China's remarkable waters.

Perhaps the most important feature of this kind is the presence of two huge rivers that drain much of the Chinese countryside—the Chang Jiang (Yangtze), the longest river in China, and the Hwangho (Yellow), the second longest. In terms of sediment discharged into the ocean, these rivers annually contribute a combined total of nearly two billion tons, or about 15 percent of the total world budget. The volume of sediment derived from the rivers each year equals about one-half of a cubic mile, or about four times the total volume of material used to construct the Great Wall of China. Of the two rivers, the shorter Hwangho, although it has a far smaller water discharge, has by far the larger sediment load, the result of its draining the loess plateaus of northern China of silt-sized sediments deposited during Pleistocene glaciations. The fine-grained, easily eroded sediment accounts for most of the 1.4 billion tons of material carried downriver each year to the sea by the Hwangho and is what gives the "Yellow River" its name.

The Chang Jiang, while carrying a smaller sediment load (about 550 million tons, nearly twice that of the Mississippi), is the fourth largest river in the world and not only provides China with water for agriculture but also serves as a major transportation route to the interior of the country. Nearly half of China's one billion people live in the watershed of the Chang Jiang, and Shanghai, at the river's mouth, is the country's major port and



The American research vessel Oceanographer *riding at anchor off Amoy, a coastal city about 500 miles south of Shanghai.*



Frederick J. Hoetzl

Joe Le Monnier



largest city, with a population in excess of eleven million.

Another feature of China's marine geology that is of particular interest is the very broad continental shelf in the East China Sea. Shelf widths are greater than 300 miles (more than twice the width of most other shelves), giving this shelf dimensions approaching those of the epicontinental seas, those ancient, broad, shallow seas that spread on the continents and from which thick sequences of sediments were deposited. Many of the substantial Paleozoic and Mesozoic sedimentary sequences in the central United States, for example, accumulated in waters substantially shallower than 300 feet. The East China Sea is one of the few modern analogs of an epicontinental sea. Hence, by learning how sediment enters and accumulates in the East China Sea, we may begin to understand how the ancient epicontinental seas developed. Moreover, the shelf of the East China Sea is the site of an extremely active fishing industry and may also hold vast stores of petroleum, two factors that make its study economically as well as scientifically interesting.

Because of China's recent turbulent history, neither the country's large rivers nor the East China Sea have been studied in detail by modern oceanographic methods. Political considerations kept Western nations from working off the China coast for the last thirty years, and kept many Soviet-bloc countries from working there for the last twenty. More importantly, the Cultural Revolution played havoc with Chinese research efforts. Many leading Chinese marine scientists spent part of the decade from 1966 to 1976 working on farms and in factories rather than in scientific institutions. Entire laboratories were closed, and the flow of foreign journals into most scientific libraries was cut off completely. Some Chinese libraries I have visited have gaps as great as six years in their collections of Western journals. Hence, at a time when the marine and earth sciences were flourishing outside of China, with a proliferation of data on such subjects as plate tectonics and continental drift, inside the country these disciplines languished. At the end of the Cultural Revolution, when contacts with Western countries were finally renewed, Chinese scientists found themselves in much the same situation as Rip van Winkle: while time had stood still for them, the rest of the world had changed markedly.

In the past four years scientific exchanges between China and other countries have increased dramatically. Chinese scientists now regularly attend international conferences and visit selected scientific institutions in the West. Through these ever increasing contacts, Chinese scientists have been brought abruptly into the 1980s. In the marine sciences, ships and new equipment are being built and purchased at a pace that would make any American oceanographer envious. (Not entirely facetiously, I asked several of my Chinese friends if we could import the "Gang of Four" to the United States in order to hasten the acquisition of newer and better equipment and ships.)

It was under these circumstances that a group of eleven U.S. marine scientists set out this past summer to work with a group of fifty Chinese scientists in the East China Sea and the Chang Jiang River. The group from the United States was interested in studying processes related to the Chang Jiang River and the broad continental shelf. Our Chinese colleagues were interested in learning more about U.S. technology and approaches to scientific problems.

The program stemmed directly from a cooperative research agreement on sediment dynamics, signed in the spring of 1979 between the National Bureau of Oceanography of China and the National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce. Unlike many government-to-government agreements in which the work is handled almost exclusively within governmental agencies, both sides agreed that much of the work would be done by scientists from universities and independent agencies. The Chinese scientists came from various universities, research laboratories, and governmental bureaus. In the American delegation, a total of eight universities and research institutes from different parts of the country (in addition to NOAA personnel) were represented. (Additional funding for the project was supplied by the U.S. Office of Naval Research and the National Science Foundation, and the National Geographic Society provided some travel money.)

To understand the interaction between the Chang Jiang River and the East China Sea a number of specific but interrelated questions must be answered: (1) How are the water and sediment loads (both suspended and dissolved) transferred from the river to the sea? (2) Where is the sediment transported after introduction to the sea at present and where was it transported within the recent past? (3) How are the transfer and transport of sediment affected by the current and tidal regimes of the area? (4) What is the interaction between the sediment and benthic organisms (those found on the sea floor)? On this last point, it is important to understand that in areas with relatively low rates of sediment accumulation, organisms can significantly alter depositional patterns through biological activities, enhanc-

ing or retarding the processes of deposition and/or erosion and altering the chemical composition of both constituent grains and pore waters. In the inner East China Sea—where the rates of sedimentation appear to be high—one might suspect that the role of organisms would be somewhat reduced, with the rapidly accumulating sediment restricting the activity of many species and, in general, masking organisms' biological impact on the sediments.

Finally, to understand completely the interaction of the river and the sea, we must consider the recent history of the area. Two points are of particular interest. First, during the last glaciation, about 30,000 to 18,000 years ago, sea level fell as much as 300 to 400 feet below the present-day level—a result of the utilization of seawater in the buildup of continental glaciers. Although there is little sea-floor evidence to show the former path of the Chang Jiang, we believe that during the maximum lowering of the sea level the river's path extended across the emergent continental shelf and emptied into the Okinawa Trough. As the sea transgressed over the continental shelf during the last glacial melting, 5,000 to 15,000 years ago, the Chang Jiang River channel was probably buried by sediment, so that no present-day trace of it can be seen on the sea floor. The location of this relict channel, and its dimensions, are therefore not known.

The second point of interest is the effect of human activities on the sediment load carried by Chinese rivers. This impact is difficult to gauge. Poor agricultural practices over the past several thousand years have greatly increased erosion of the land. As a result, the high sediment loads that characterize China's rivers may be far greater than the prehistoric loads.

To grasp fully the interrelations between these various processes and problems requires the integration of a number of separate but interacting disciplines, among them, geology, physical oceanography, chemistry, and biology. The American group included scientists prepared to study the transfer of Chang Jiang water to the sea, the movement of Chang Jiang water and other water masses in the East China Sea, the transfer of dissolved and suspended loads to the sea, the movement of sediment on the surface of the sea floor in response to currents and waves, the geotechnical properties of sediments and their history, the morphology and shallow structure of the sea floor, the rates of deposition of sediments and their chemical alteration, and the effects of biological interaction on bottom sediments.

To carry out a program that addressed such a diversity of topics, several ships and many well-coordinated schedules were required. After considerable negotiation, a decision was reached to undertake a preliminary cruise in June of 1980, so that the scientists from the United States could learn more about the river and its adjacent shelf and scientists from each country could evaluate the equipment and techniques of the other. Three ships were to be used, one from the United States and two from China, and scientists, equipment, and crews from the two countries were to be exchanged. One of the Chinese ships (*Shu Guong*, or *Dawn #6*) would work in the Chang Jiang estuary, studying the transfer of water and sediment loads to the sea; the other Chinese ship (*Xiang Yang Hong*, or *Turning Red by the Sun #9*) would be responsible for sampling sediment throughout the entire area and for making oceanographic observations on the in-

Transfer of sediment from the Yangtze River to the East China Sea can be seen in this composite picture made from two Landsat satellite images of the mouth of the river. Although both images were made at an altitude of 570 miles, the one at the right dates from April 1975 and the one on the left from August of 1979. Runoff is greatest during the rainy season, from about June through August, but as is shown here, heavy cloud cover in this period interferes with satellite imagery.



NASA Landsat photographs

nermost shelf. The American ship, R/V *Oceanographer* (from NOAA, Seattle), was to be responsible for deploying several arrays of current meters on the shelf, for taking hydrographic measurements of waters on the middle and outer shelf (at times coordinated with the observations made by the Chinese ships), and for carrying out most of the geophysical and geomorphic studies.

This was to be the first cooperative oceanographic field program between scientists of two countries that had been antagonists for the preceding thirty years, and as might be expected, many areas of potential conflict had to be straightened out prior to the departure of the ships from Shanghai. Some points of contention (such as who would ultimately retain the original data) were not agreed on until a few hours before the ships sailed. Moreover, the exchange of equipment and personnel between ships presented countless problems. For instance, consider the difficulties of trying to operate U.S. instruments on Chinese ships wired for different electrical power and equipped with different ocean winches. Nevertheless, our agreement on the ultimate objectives of the project made us optimistic about the forthcoming cruise.

The three ships sailed from Shanghai on June 9, 1980, marking the beginning of what was the first international cooperative study of the Chang Jiang River and its adjacent waters. Sailing out the Chang Jiang from Shanghai is an intriguing experience for scientists and nonscientists alike. As we approached the mouth of the river, the tan waters turned brown near the ever present shoals. Where ship propellers stirred the bottom, the water became dark brown, creating a patchwork of tan, brown, and chocolate. Across this mosaic sailed a wide variety of craft—modern cargo ships, junks, fishing boats, and even the occasional passenger liner—most of them go short distances to and from Shanghai, but some go as far upriver as Chungking, more than a thousand miles from the coast.

During high river runoff in the summer, the tan-colored freshwater plume can extend many miles offshore. About thirty-five miles from the coast, however, the bottom deepens, the water becomes more saline, and the suspended sediment settles from the surface. The increased clarity of the water stimulates the growth of plankton in the nutrient-rich, river-derived water, turning the offshore water green. This proliferation of plankton ultimately results in a high production of fishes, which, in turn, attract hordes of fishing boats of all sizes, most of them from China, Japan, Taiwan, and Korea. (When towing scientific instruments from an oceanographic ship, one must always keep a lookout for small fishing boats that might dart across the wake and cut the towing cables.)

The *Shu Guong #6* carried eighteen Chinese scientists and technicians and five American, and its work was restricted to the river and estuarine waters. Among other tasks, this ship was assigned to anchor at a series of specified stations for 27-hour periods, so that variations in temperature, salinity, currents, and dissolved and suspended loads could be monitored. As the tide rises and falls, the discharge of river water decelerates and accelerates correspondingly. Maximum currents are associated with ebb tide and minimum currents with flood tide. During the maximum outflow, we found suspended sediment present in amounts that periodically exceeded four grams per liter—concentrations 100 to 5,000 times higher than those recorded in offshore waters. Perhaps even more interesting was the observation that most of the water and sediment from the river hugs the southern coast as it leaves the river mouth, apparently little of it escaping directly offshore or to the north.

The team on the *Xiang Yang Hong #9* included thirty-five Chinese and seven Americans. Despite the considerable problems the Americans encountered in working with Chinese equipment, this group was able to obtain numerous geologic and biological samples from the bottom. In nearshore areas, the fine-grained bottom sediment was highly laminated, suggestive of rapid accumulation. Interestingly, farther offshore the sediment was coarser, but also laminated. D. C. Rhoads of Yale University feels that these sands are periodically resuspended by currents. This would prevent colonization by benthic organisms, thereby giving the sediment its laminated character.

The team on the *Oceanographer* also included more Chinese (thirteen) than Americans (five) and its work was concentrated in mid-shelf areas. Profiles of the water column, using conductivity, temperature, and depth probes, showed the offshore waters to be a two-layered system, with warmer, less saline waters overlying colder, more saline waters. The density gradient between the two is remarkably sharp. Suspended particles above the gradient are composed primarily of biologically produced material, while the bottom waters mostly contain sediment from the river, suggesting that the two layers are almost decoupled from one another. Occasionally, plankton concentrate at the density discontinuity—a phenomenon that has often been observed elsewhere.

Mapping the sea floor revealed that much of the bottom of the East China Sea consists of well-rippled sand, although some areas were unrippled or included only scattered outcrops. Subsurface seismic profiles crossed a number of areas in which filled channels—possibly those of the Chang Jiang—could be detected. The depth of the channel indicates that it was probably riverine until about ten thousand years ago, after which it became filled with about eighty-five feet of sediment. Further profiling in the area should delineate the extent of this buried channel.

Only a few months have passed since the U.S. scientists returned home and an even shorter time has elapsed since all of our samples arrived. Clearly, it is too early to draw any far-reaching conclusions about the significance of our observations from this one cruise and there is no question that further cruises are needed. One is already planned for the summer of 1981, during flood season, and one for the late autumn of 1981, when runoff should be far lower. Observations made during the initial 1980 cruise will help define areas of special interest that should be studied further. It is already apparent that the region of the East China Sea immediately south of the Chang Jiang, where most of the river water appears to escape, warrants such attention. Now that Chinese and U.S. scientists have worked successfully together once, future efforts should go more smoothly. It is perhaps fitting to note than even with the problems of logistics and equipment and a variety of bureaucratic snags, all the U.S. scientists are eager to continue the studies next year. Considering that for most of us our first introduction to China and its oceanography took place less than a year ago, we have moved very far very quickly. □

DINOSAURS BY MAIL

Distinctive umbrellas and totes, and other rare species from The Museum.









Dinosaur Umbrella, 48″ diam. Cotton poplin. Burgundy/beige. Wood handle. #120 **$25.** Members **$22.50.**
Dinosaur Tote, waterproof-backed cotton canvas; zipper. Burgundy/beige. 8x16″ #121 **$17.50.** Members **$15.75.**
Duck Bookends of brass and pewter, 5½″ high. #124 **$32** a pair. Members **$28.80.**
Stuffed Tiger. Adaptation of 19th Century Chinese Toy Cotton; natural dyes; kapok fill. 7″ tall. #157 **$26.** Members **$23.40.**
Tiger Kit; fabric, instructions. #158 **$14.** Members **$12.60.**



Hand-Puppet Bear, Fur-like acrylic stuffed with polyester. Approx. 11½″ #148 **$30.** Members **$27.**

American Museum of Natural History

Museum Shop Dept. 227 P.O. Box 174 Scarsdale, N.Y. 10583

Item	Qty.	Description	Price	Shipping/ handling	Total
120		Dino umbrella		3.00 ea.	
121		Dino Tote		2.00 ea.	
124		Duck bookends		3.00 ea.	
148		Bear handpuppet		2.00 ea.	
157		Stuffed tiger		2.00 ea.	
158		Tiger kit		1.50 ea.	
				Order Total	
				N.Y. Sales Tax	
				Total Amount	

Most deliveries will be made by U.P.S. so please provide street address

☐ Member ☐ Membership # _____ ☐ Non Member

☐ I've enclosed check or M.O. in the amount of $_____ payable to American Museum of Natural History (NO C.O.D'S)

Charge to ☐ Master charge ☐ Visa ☐ American Express

Account # _____ Exp. Date _____

Signature (req. if using credit card) _____

Please print
Name _____

Address _____

City _____ State _____ Zip _____

Customer inquiries: Call 212-799-8958

Food and the Fetus

Pregnant women are now being advised to gain more weight than was previously recommended in order to insure survival of the fetus and the newborn infant

by Myron Winick

Over the past few years, one of medicine's fundamental beliefs about pregnancy and the development of the human fetus has been challenged. Until recently the fetus was viewed as a parasite capable of extracting the nutrients it needed from the vast stores contained within the mother's body. For this reason nutrition during pregnancy was not considered very important for the average mother, and weight gain was kept to a minimum with the rationale that this would protect the mother from future obesity and in no way affect the growth and development of the fetus. We know today that neither of these statements is true. Weight restriction during pregnancy will not protect the mother from future obesity and the fetus will not grow properly if the mother's weight gain is insufficient. To understand why this is true, it is necessary to examine some of the physiological adjustments that a woman's body makes during pregnancy and the way in which these adjustments are affected by nutrition.

Early in pregnancy the uterus begins to grow in order to accommodate the developing fetus. In addition, the blood flow to the uterus increases markedly since much more blood will be necessary to supply the nutrients and remove the waste products passing to and from the fetus through the placenta. For this increase in available blood to take place without interfering with the mother's own needs, her total blood volume must also increase. Thus early pregnancy is characterized by a series of changes that include an increase in maternal blood volume, an increase in uterine blood flow, and the development of the placenta with its rich blood supply. Recent studies have shown that inadequate nutrition affects all these processes, reducing the increase in maternal blood volume and both uterine and placental blood flow. If the mother is undernourished early in pregnancy, the "lifeline" to the fetus will be inadequate and nutrients will not be efficiently transported to the fetus.

As pregnancy proceeds, the mother undergoes further adaptation to insure proper fetal nutrition after birth. The breasts, which will become the organ capable of producing the infant's total food supply, begin to grow and to develop the capacity to synthesize milk. In addition, fat is carefully laid down in deep sites within the body to store the energy necessary for lactation. The mother will expend more energy during the period of lactation than at any other time of her life, and her body begins to prepare for this effort during pregnancy. In fact, the preparations for lactation are so important that if the mother is inadequately nourished, they will take place even at the expense of fetal growth. The logic of this system is more easily understood when we remember that until the advent of infant formulas before the turn of the century, no infant could survive without successful breast feeding. Thus, infant growth is less of a priority than adequate preparation for lactation, and a mother who is inadequately nourished will continue to deposit fat even though fetal growth is slowed.

For the fetus to grow properly, the mother's metabolism must adapt not only in early pregnancy so that enough maternal blood will circulate through the placenta but also in middle and late pregnancy so that enough fat will be deposited to insure an adequate ability to lactate. To accomplish this second goal, another series of adaptive changes usually takes place. In particular, the mother's appetite increases and she begins to consume more food. Moreover, certain changes occur in her gastrointestinal tract, resulting in the more efficient absorption of a number of specific nutrients, including iron and calcium. (As we shall see, the fetus needs these substances in particularly large amounts.)

When food is abundant these adaptive changes work extremely well.



Keep up with the FUTURE!

Get a Charter Subscription to

NEXT now only $9.99

Yes, I'd like a Subscription to NEXT; 6 bimonthly issues for only $9.99 (regular newsstand price $12.00). If not delighted I may write "Cancel" on the bill, return it unpaid, keep my first issue FREE, and not be obligated further in any way.

☐ $9.99 payment enclosed
☐ Bill me later

Name_____

Address_____

City_____ State_____ Zip_____

NEXT is published every other month, so please allow up to 8 weeks for your first copy to arrive

NINH1

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD

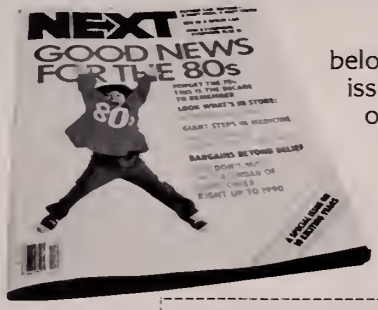
FIRST CLASS PERMIT NO. 6738 DES MOINES, IA

POSTAGE WILL BE PAID BY ADDRESSEE

NEXT

P.O. BOX 10109
DES MOINES, IA 50349

WHAT'S NEXT?



Get A Sample Issue And Find Out!

NEXT is an exciting new magazine that looks into the future — your future. Not a science magazine, or a science-fiction publication, NEXT brings you a considered look at what the experts think your life will be like in 2 years, 5 years, 10 years and beyond.

What you'll find in NEXT will fascinate you, for, as you'll see, the world is on the brink of far-reaching changes that may touch every phase of your life — your health, your job, where and how you'll live, how you'll travel, your pocketbook, your social life, your political beliefs, even what you'll eat and where you'll spend your vacation.

NEXT is written for the general reader — concise, lively, provocative, without technical jargon. And every issue is filled with forward-looking articles such as: How We'll Soon Control The Weather; New Cures for Anxiety and Depression; How You *Can* Obtain Financial Security; The New Sexual Morality; Tomorrow's "Beautiful People" — Who They'll Be; How You'll Shop By TV; and The Ultimate Solution to Inflation.

But why not see what's next for yourself? You can start a subscription to NEXT by mailing the coupon below. What's more, after your first issue, if you wish, you may cancel and owe nothing; so you've got nothing to lose.

MAIL COUPON BELOW OR CALL TOLL-FREE 800-247-5470. In Iowa call 800-532-1272

Mail to:

NEXT P.O. Box 10109, Des Moines, IA 50340

Yes, I'd like a subscription to NEXT; 6 bimonthly issues for only $9.99 (regular newsstand price $12.00). If not delighted I may write "CANCEL" on the bill, return it unpaid, keep my first issue FREE, and not be obligated further in any way.

☐ $9.99 payment enclosed
☐ Bill me later

Name _____

Address _____

City _____ State _____ Zip _____

NEXT is published every other month, so please allow 8 weeks for your first copy to arrive.

NUNKO

When food is scarce, however, fetal growth is retarded. For example, in 1945 during the famine imposed by the Nazis in Holland, birth weight dropped significantly. Today in several rural Guatemalan villages average birth weights are noticeably low and studies have shown that they can be made to rise significantly by increasing the amount of food available to pregnant women.

Data such as these have led to a reevaluation of feeding practices during pregnancy and a series of recommendations that are quite different from those of only ten years ago. Doctors now advise that a woman consume enough calories to gain at least twenty-five pounds during the course of pregnancy. This can be determined by studying pregnant women who are neither urged to eat nor discouraged from eating and totaling the average weight gained as a result of the various maternal adaptations to pregnancy and the average weight of the fetal components and the placenta. More precisely, the uterus and breast tissue increase about one and a half pounds each; the increased maternal blood volume accounts for more than one pound; and the mother deposits ten to twelve pounds of fat. Thus the maternal adaptation accounts for about fourteen to sixteen pounds. The fetus weighs seven to eight pounds; the placenta, one to two pounds; and the amniotic fluid, which bathes the fetus, about one pound. The fetal compartment therefore represents nine to eleven pounds, making a total weight gain of twenty-five pounds.

Left to their own devices, most women do gain about twenty-five pounds during pregnancy, and statistics show that a normally nourished woman with a weight gain of twenty-five pounds can expect to produce an infant of about eight pounds. It should be noted that women who are underweight prior to pregnancy need to gain more than twenty-five pounds to produce an infant of comparable size, whereas women who are overweight prior to pregnancy, although able to gain somewhat less weight, must still gain a minimum of about fifteen pounds. The crucial element involved in this weight gain is calories. If the number of calories consumed daily is increased by 300 to 500, a twenty-five pound weight gain will result.

Why are we so concerned with adequate fetal size? Statistically, an infant has a better chance to survive and develop normally after birth if its birth weight is not low. Some statistics in the United States illustrate this point dramatically. The United States has only the eighteenth lowest rate of infant mortality in the world. In other words, an infant born in seventeen other countries (including Japan, Australia, and the German Democratic Republic) has a better chance to survive than one born in the United States—not a record to be proud of.

Most of the high rates of infant mortality are found in the poorer segments of the U.S. population, particularly among blacks. In some groups, infant mortality may be two to three times as high as among middle-class populations. But pound for pound, the poor baby does as well as the rich baby; black babies do as well as white babies. The difference in mortality can be entirely explained by the fact that babies from these disadvantaged groups weigh on the average half a pound less at birth than middle-class babies. Theoretically at least, if we could raise the average birth weight in this portion of the population by a half pound, we could erase the difference and significantly reduce our overall infant mortality. Poor maternal nutrition is certainly one of the many factors contributing to this low birth weight.

Thus the first and most important dietary recommendation for pregnant women is to increase their food intake so that the number of calories they consume daily increases by 300 to 500. From the standpoint of fetal growth, the source of these calories is not important. For example, in the study in Guatemala previously mentioned, when 20,000 extra calories were supplied throughout the course of the pregnancy, birth weight increased by nearly one pound. Whether the source of those calories was primarily protein or carbohydrate made no difference—a surprising finding since protein is essential to enable an infant to build new tissues. Recent experiments with animals may provide an explanation.

Rats fed a restricted diet have smaller pups at birth, and supplementation with either protein or carbohydrate returns pup size to normal. The composition of the mother's body changes markedly, however, depending on which type of supplement is used. If protein is supplied, the composition of the mother's body remains essentially normal for pregnancy. If carbohydrate is the sole source of the extra calories, however, maternal muscle tissue breaks down to supply the amino acids that would have been supplied by the dietary protein. In other words, a sufficient number of calories from any source will allow the mother to make the adaptations necessary to support the fetus, but unless protein is supplied, the fetus will derive amino acids from the mother's body. In this situation the fetus does become a parasite. For that reason it is indeed important for a pregnant woman to include a significant amount of protein in the foods with which she supplements her normal diet.

The present recommendation is that a pregnant woman increase her daily intake of protein by thirty grams. If the mother is on a reasonably balanced diet, this can be accomplished by simply increasing the amount of food she consumes. Certain specific nutrients are required in particularly large amounts in pregnancy, however, because of the special demands of the mother, the fetus, or both. These are the minerals iron and calcium and certain vitamins such as folic acid and vitamin B_6.

Iron is an integral part of the hemoglobin molecule and is therefore an essential component of blood. With the expansion in the volume of maternal blood, more iron is needed by the mother. Moreover, the fetus must manufacture its own blood supply—a supply that increases with fetal growth; hence large amounts of iron are needed by the fetus as well. Iron is normally present in only marginal amounts, however, and although iron is absorbed much more efficiently during pregnancy, in the past when the mother's intake of food was limited, iron intake had to be supplemented to prevent deficiency. Even now that the mother's food intake is being increased, supplementation during pregnancy is advisable unless special care is taken to consume iron-rich foods (for example, red meats, fortified grain products, beans, and dried fruit).

Calcium is necessary for proper development of the fetal skeleton and therefore is required in increased amounts during pregnancy. Supplementation is not usually necessary, however, since the mother's absorption of calcium from foods is markedly increased. (But because dairy products are an important source of calcium, a woman following a strict vegetarian regime during pregnancy may wish to take both calcium and iron supplements.) On the other hand, cal-

cium absorption depends in part on the amounts of other nutrients in the diet. For example, phosphorus has an important effect on calcium absorption; the higher the concentration of phosphorus in the mother's diet, the less calcium is absorbed. One major source of phosphorus in the American diet is certain types of carbonated soft drinks. Therefore, it is a good idea for a pregnant woman to limit her intake of those drinks.

One nutrient for which the increased requirement in pregnancy cannot be satisfied by a balanced increase in the amount of food consumed is folic acid, a vitamin necessary for cell division. The American diet barely satisfies the body's normal demand for this vitamin. In fact, folic acid deficiency is among the most common of vitamin deficiencies. During pregnancy, when both the uterus and the mother are manufacturing many new cells, supplementing the intake of folic acid is advisable unless special care is taken to consume foods rich in the vitamin. Special attention must also be paid to providing the fetus with a sufficient amount of vitamin B_6 (pyrodoxine). This vitamin is generally available in a normal diet, but in women who were on contraceptive pills for a long time prior to pregnancy, B_6 stores may be depleted and, at least early in pregnancy, supplementation may be warranted.

If we have learned anything about pregnancy in the past decade, it is that maternal nutrition and maternal weight gain during pregnancy will directly affect fetal growth. During pregnancy the mother must prepare herself so as to insure both the survival of the fetus and the survival of the infant after birth. To put it simply, poor nutrition interferes with these preparations and serves to retard the growth of the fetus. Thus mothers should eat more and gain more than was recommended in the past. For most women, just following the dictates of their appetites will result in the required minimum gain of twenty-five pounds. In this way they will allow their fetus to grow properly and at the same time prepare themselves adequately for the period of lactation that may follow.

Myron Winick is the director of the Institute of Human Nutrition and a professor of nutrition and pediatrics at the College of Physicians and Surgeons at Columbia University.

YOU CAN TAKE IT WITH YOU



C5 Telescope

Tiger —
750mm f/6 photo





C8 Telescope with
35mm camera attached

35mm photography
is as easy as adding
your camera for exciting
close-ups of your favorite subjects.

CELESTRON telescopes and telephoto lenses are compact and lightweight. The modern Celestron design means you can take it anywhere and have it set up and operating in minutes. Under clear, dark, steady skies, the amount of detail seen through Celestron telescopes borders on the fabulous. As a daytime telescope, see or photograph ships, planes, wildlife and people at incredible distances with complete clarity. Apertures available from 3-1/2" to 14" priced from $295.00. Celestron also has a full line of binoculars of astronomical quality.



C8 one-hand
portability

Send $2.00 for 32-page full color
catalog on how to select and use
a Celestron telescope or telephoto lens.

(DEALER INQUIRIES INVITED)

Celestron

CELESTRON INTERNATIONAL, 2835 Columbia St., Box 3578-NH Torrance, CA 90503, U S A
(213) 328-9560

The Solar Shrink

Whether the sun is now—or ever has been—shrinking is a matter of dispute

by Stephen P. Maran

"Our wishes lengthen as our sun declines," wrote the English poet Edward Young (1683–1765). A few astronomers now believe that the sun is indeed declining or, more specifically, that it is shrinking, and they have revived an almost-forgotten controversy on the subject.

Obviously, no dramatic change is under way on the sun or we would all know about it, since the amount of light and heat reaching the earth depends on the size and temperature of the sun. If the sun pulsated noticeably, alternately shrinking and swelling like the variable star Mira, for example, there would be correspondingly radical trends in the earth's weather. The possibility remains that the sun may be shrinking slowly, with imperceptible immediate effects. However, even a slight but continuing change would eventually be reflected in a detectable climate change on the earth.

The current controversy was ignited in 1979 by two Boston-area researchers, John A. Eddy, then with the Center for Astrophysics in Cambridge, Massachusetts, and Aram Boornazian, with the private research firm of S. Ross and Company. But the debate goes back at least to 1809, when the great German mathematician and astronomer Karl Friedrich Gauss disputed a report that the sun's size had decreased during the latter half of the eighteenth century.

The evidence Gauss took issue with, like much of the evidence in the current controversy, consisted of direct measurements of the diameters of telescopic images of the sun. The alleged shrinkage under consideration today is so small—amounting at most to a decrease of a few feet per hour in the 865,000-mile solar diameter—that finding it depends on very small changes in the measurements of the images from year to year and decade to decade. Nevertheless, the solar image is blurred by our dusty and turbulent atmosphere, and critics claim that the reported trend may be due to changes in the telescopic equipment or in the atmosphere or to switches in the observing astronomers. In fact, analyses of solar-diameter measurements made at different observatories yield different results.

Some statisticians have found a shrinkage in the measurement data, some have found none, and some have claimed to detect gradual up-and-down trends in the solar diameter, as though the sun *were* pulsating like Mira, albeit by a vastly smaller amount and over a much longer period. The claimed periods, depending on which report you read, include ones of eleven years (the length, incidentally, of the sunspot cycle) and of twenty-two years (the length of a related phenomenon called the solar magnetic cycle). In view of the conflicting reports, about the only thing we can conclude at the present time is that the direct diameter measurements do not provide unequivocal evidence for *any* change in the size of the sun. There are, nevertheless, indirect ways of gauging the solar diameter that may be less affected by changes in the observing equipment, the observing personnel, and the earth's atmosphere.

One way to check on any change in the size of the sun is to investigate the accumulated observations of the transits of Mercury. (The transits are the passages of that tiny planet in front of the sun, as seen from the earth. They occur about thirteen times per century.) During transits, Mercury looks like a black dot against the brilliant solar surface; by timing the duration of a transit, one can deduce the size of the sun. In April 1980, a physicist at the Massachusetts Institute of Technology reported that analysis of transit timings made from 1736 to 1973 showed no solar shrinkage, although the data were capable of revealing a shrink rate six times smaller than had been claimed by Eddy and Boornazian.

Observations of eclipses of the sun represent another source of indirect information on the solar diameter. Surprisingly sensitive determinations can be made from very simple observations of eclipses. The size and orbit of the moon are known with high precision, as are the orbit of the earth and the earth's distance from the sun. Thus, it should be possible to calculate the circumstances of a solar eclipse with considerable accuracy. The calculations can then be compared with actual observations. For example, if the sun were larger than assumed, then the extent to which it is covered by the moon would be diminished, and the umbra, or shadow of the moon cast on the earth during a solar eclipse, would be narrower than expected. As the umbra moves across the earth, it traces out the "path of totality." If the sun were smaller than assumed in the calculations, the path would be wider than was computed and the duration of totality witnessed by a fixed observer on, say, the center line of the path would be longer than predicted.

In fact, an account of a sixteenth-century eclipse was used as an argument for the validity of solar shrinkage by Eddy and Boornazian, who also found an apparent decrease in the direct measurements made during the years 1836 to 1953 at the Royal Greenwich Observatory in England and from 1846 to 1950 at the U.S. Naval Observatory in Washington, D.C. They cited a description of the eclipse of April 9, 1567, written by the Ger-

man mathematician Christopher Clavius. Clavius, after whom a huge crater on the moon is named, observed the eclipse from Rome. Despite modern computations that indicate that this eclipse should have been total—although barely so—Clavius found that "a certain narrow circle was left on the Sun, surrounding the whole of the Moon on all sides." He apparently did not mean the solar corona, which resembles a broad patch of light around the sun during a total eclipse, and he was familiar with what to expect since he had studied an earlier total eclipse in 1560.

A bright ring of light is seen in an annular eclipse, that is, one that is not total because the moon is too far out in its elliptical orbit to block out the whole sun. Eddy and Boornazian argued that the 1567 eclipse was annular for a different reason, namely, that the sun was bigger in 1567 than allowed for by the computations, which are based on the modern value of the solar diameter.

Having witnessed several total eclipses of the sun myself, I was impressed by the above argument. In particular, I found it hard to accept a countersuggestion proposing that Clavius's "circle" consisted of light from the bright innermost zone of the solar corona. No part of the corona has ever seemed bright enough to me to be mistaken for a part of the far more intense solar surface. However, there is an explanation of what Clavius saw that does not require so exotic a phenomenon as a shrinking of the sun. According to John Parkinson, an experienced solar astronomer at University College, London, it is not sufficient to regard the edge of the moon as a circle of a certain size when you calculate the circumstances of a *barely* total eclipse. In such cases, you must allow for the topographic high and low spots around the lunar periphery.

Where there is a low spot on the moon's edge, a bit of the bright solar surface may still shine through, although the eclipse is supposedly total. This phenomenon occurs for only an instant during an ordinary total eclipse, either just before or just after the phase of true totality. Eclipse viewers call these momentary bright spots "Baily's beads," after a nineteenth-century English astronomer. Parkinson reports that a recalculation of the 1567 eclipse, which takes the hills and valleys of the moon into account, has been done at the Royal Greenwich Observatory. The results reveal that the eclipse would have featured an extreme case of Baily's beads, with a great many bright spots, like an outbreak of solar measles, all around the moon's edge. Further, the bright spots would have persisted throughout the phase of totality, so that in a sense the eclipse was not truly total. This string of Baily's beads might fairly have been called a "circle" by Clavius, who viewed the eclipse without a telescope.

There remains one report of solar shrinkage for which there is not yet any seriously conflicting evidence. This finding, by five American, Australian, and English astronomers led by David W. Dunham of the Computer Sciences Corporation in Silver Spring, Maryland, and Sabatino Sofia of the Goddard Space Flight Center in nearby Greenbelt, is based on determinations of the width of the path of totality at solar eclipses in 1715, 1976, and 1979. The 1715 eclipse was viewed from many locations in southeastern England at the behest of Edmond Halley of comet fame. The Dunham and Sofia analysis of the English reports shows exactly where in the Kentish countryside the northern and southern edges of the path of totality went.

There is no measurable difference in the determinations of the solar diameter from the 1976 and 1979 eclipses, which is hardly surprising given the short interval between the two events. However, the width of the path of totality in 1715 implies a very slightly larger sun. Taken at face value, there was a decrease of about 400 miles in the size of the sun over 264 years. Although this shrinkage is so small as to be near the limit of detectability in the available data (but too small to be ruled out by the transit of Mercury measurements), it nevertheless cannot have been under way over truly long periods of time. In fact, a shrinkage at this rate would reduce the sun to nothing in less than one million years. More likely, if the claimed shrinkage effect is indeed real, the sun must periodically reverse itself and slowly enlarge again. At least, let's hope so.

Stephen P. Maran is senior staff scientist in the Laboratory for Astronomy and Solar Physics at NASA's Goddard Space Flight Center in Greenbelt, Maryland.

PARK'S FREE 1981 CATALOG

ATTENTION GARDENERS!

PARK OFFERS YOU:

- OVER 3,000 VARIETIES OF FLOWERS & VEGETABLES
- 113 YEARS OF EXPERIENCE
- CULTURAL INFORMATION
- HIGHEST QUALITY
- BEST PERFORMANCE

SATISFACTION GUARANTEED!

Seed Specialists Since 1868

Send This Coupon To:

Geo. W. *PARK SEED* Co., Inc.

188 Cokesbury Rd., Greenwood, S. C. 29647

Name _____

Address _____

City _____

State _____ Zip _____

132 Page Full-Color Catalog!

LYNCHBURG HARDWARE & GENERAL STORE

65 Main St., Lynchburg, TN 37352



JACK DANIEL SQUARE GLASS SET

Mr. Jack Daniel was the originator of the square bottle for his whiskey and always wanted to have a matching square glass. Well, here it is! This hefty square glass (each weighs 14 ounces) is the perfect companion to a bottle of Mr. Jack's finest. The inside is rounded to make drinking a pleasure and the original design is fired on for good looks and durability. My $15.00 price for a set of 4 glasses (8 oz. capacity) includes postage.

Send check, money order, or use American Express, Visa or Master Charge, including all numbers and signature.

(Tennessee residents add 6% sales tax.) For a color catalog full of old Tennessee items and Jack Daniel's memorabilia, send $1.00 to above address.



Enter the world of Questers nature tours.

When you travel with Questers, you have the advantage of our knowledge of the travel world And our experience of the natural world We are travel professionals And our only tour program is Worldwide Nature Tours.

Under the leadership of an accompanying naturalist, we search out the plants and animals, birds and flowers rain forests, mountains, and tundra seashores, lakes, and swamps of the regions we explore At the same time, we include the more usual attractions in touring—the cities, archaeological sites, and people

The current Directory of Worldwide Nature Tours describes 29 tours varying from 9 to 36 days and going to virtually every part of the world Included are The Amazon, Peru, Patagonia, Galapagos, Hawaii, Alaska, Death Valley, Everglades, Ladakh, Sri Lanka, Iceland, Scotland, Greece, Australia, and New Zealand Tour parties are small, the pace leisurely, and itineraries unusual

Call or write Questers or see your Travel Agent today for your free copy of the Directory of Worldwide Nature Tours



QUESTERS

Questers Tours & Travel, Inc.
Dept. NH-181, 257 Park Avenue South
New York, N.Y. 10010 • (212) 673-3120

Share the Thrills of Exploring Outer Space!



$279.95 f.o.b. Hartford, Conn.

$15 Crating Charge

Now it's easy to join the thousands of serious amateurs who have discovered the excitement of exploring our mysterious universe. Your enjoyment begins right from the start, yet the challenges and rewards go on for years! And it's a hobby that can be shared at modest cost.

Choose From Many DYNASCOPES®

Picking a telescope to fit your needs and your pocketbook is simple when you select a DYNASCOPE—the same instruments used by more than 150 schools, colleges and observatories—and your satisfaction is guaranteed by a full-refund warranty.

FASCINATING GUIDE YOURS FREE!

Read these valuable facts before buying any telescope. Mail coupon or postcard for your complimentary copy of this helpful guide.



Criterion Manufacturing Co.
620 Oakwood Ave., W Hartford, Conn. 06110

® TM Registered U.S. Pat. Office

CRITERION MANUFACTURING CO., Dept NH 99
620 Oakwood Avenue, W Hartford, Conn. 06110
Please send your free Telescope Guide.
Name_____
Address_____
City_____ State_____

Celestial Events

by Thomas D. Nicholson

The Moon Evening moonlight will be significant about mid-January and again in mid-February, when the moon is up for most of the night. The moon is a morning object until it is new on January 6. The first view of the young crescent will be on about January 9, followed by first-quarter on the 13th, full moon on the 20th, and last-quarter on the 27th. The moon will be new again on February 4, and first-quarter on the 13th. Perigee moon (nearest the earth) is on January 15 and February 8; apogee (farthest from the earth) on January 27. The light cast by the full moon in January is exceptionally bright and intense because the moon climbs so high in the sky during its nightly passage.

Stars and Planets Only Mercury and Mars are evening planets but neither is well placed for viewing. The bright planets are still morning stars but Venus is well past its best. Jupiter and Saturn are in good position. Although morning objects (above the horizon at sunrise), they rise about two hours before midnight and are high in the south by dawn. The two planets will be extremely close to each other this winter in the constellation Virgo, not far from its brightest star, Spica. Jupiter will be easiest to find because of its extreme brightness (surpassed at night only by Venus and the moon). The two planets come this close only about once every twelve years or so when Jupiter passes the slower Saturn. But one year in every hundred or more, the effects of retrograde motion cause Jupiter to pass Saturn three times within just a few months. This is the year. The first conjunction will occur on January 14 (Jupiter moving left past Saturn), the second on February 19 (Jupiter moving to the right-retrograde), and the third on July 30 (Jupiter moving to the left again).

January 1: The earth is at perihelion (nearest the sun) on New Year's Day, approximately 147,093,000 kilometers (91,400,000 miles) from the sun, some 5 million kilometers (3 million miles) closer than in July.

January 4: You can see Venus low in the east this morning, rising shortly after the waning crescent moon at about 4:30 A.M.

January 6: The latest sunrise of the year occurs. Sunset is now fifteen minutes later than it was in December, but the time of sunrise changes more slowly from mid-December to mid-January.

January 14: Jupiter is in conjunction with Saturn, moving from Saturn's right to its left.

January 16: The bright star near the moon is Aldebaran, in Taurus.

January 19: Saturn begins its retrograde (westward) motion relative to the stars.

January 20: A penumbral, or partial, eclipse slightly dims the brightness of tonight's full moon.

January 23–24: The waning gibbous moon is close to Jupiter and Saturn from the time of rising (about 10:30 P.M. on the 23rd and 11:30 P.M. on the 24th).

January 25: Jupiter begins its retrograde motion, and both Jupiter and Saturn can be seen shifting slowly away (to the right) from Spica.

January 31: Mercury is at its greatest distance (elongation) to the sun's left, leaving it above the horizon after sundown. For a week or so before and after this date, the planet will be low in the west during late twilight.

February 3: The crescent moon is near Venus again this morning, but both are probably too low to be seen in the dawn.

February 4: An annular solar eclipse (a ring of the sun remains visible around the moon at mid-eclipse) occurs in the South Pacific Ocean.

February 12: The moon is near the star Aldebaran (in Taurus) again tonight.

DISCOVER SPAIN, PORTUGAL AND FRANCE

with the American Museum of Natural History

JUNE 23 TO JULY 8, 1981

Discover with Dr. Thomas D. Nicholson, Director of the Museum, and six other scientists, all experts in their fields, the rich cultural heritage, beautiful shores and countryside of Western Europe.

Enjoy the grandeur of the Sierra Nevada, superb Moorish palaces and gardens of Granada and Seville, Barcelona's art and architecture, the famous monasteries and monuments of Lisbon, vine-clad hillsides surrounding Oporto, the pilgrim shrine of Santiago de Compostela, the Huguenot tradition of La Rochelle. Visit splendid parish closes in the rich Brittany countryside, awesome Mont St. Michel, famous medieval Rouen as the goal on a scenic cruise up the Seine. Explore coasts and valleys, fields and highlands profuse with shore and land birds, fertile with blossoming flowers.

Experience the educational holiday of a lifetime with compatible members and friends of the Museum. Travel aboard the intimate and comfortable m.t.s. Orpheus and see the superb scenery from a vantage point that most visitors can never have.



Operated for the Museum by W.F. & R.K. Swan.
The Orpheus is registered in Greece.

American Museum of Natural History
Discovery Tours

Telephone: 212-873-1440

Central Park West at 79th St.
New York, N.Y. 10024

Please send an itinerary for the Discovery Tour of Spain, Portugal and France to:

Name .....

Address .....

City ..... State ..... Zip .....

Kurt Waldheim on Asian Peoples

On October 16, 1980, the American Museum of Natural History celebrated the opening of the new Gardner D. Stout Hall of Asian Peoples. Following an introductory speech and presentation by Museum president Robert G. Goelet, Kurt Waldheim, secretary-general of the United Nations, gave a short address. We have reproduced his speech here in full. In it he outlines his view of the significance of the hall and what it symbolizes for world understanding and peace.

New York is one of the great cultural centers of the world and, as the host city of the United Nations, a political center of international life as well. The Gardner D. Stout Hall of Asian Peoples at the American Museum of Natural History makes a significant addition to the city's resources for broadening the cultural awareness of its residents and visitors.

I find it most appropriate that the theme of this exhibition should be the peoples of Asia. This lends it a special appeal and fascination. Of all continents, Asia is not only the largest; it also contains a greater variety of ethnic groups, traditions, and languages than any other. All of the great world religions originated in Asia. Some of the oldest civilizations flourished on that continent. In a broad sense, therefore, Asia represents more than Asia. Called the Mother of Civilization, it stands for a large part of the entire human heritage.

Once we realize the value and meaning of this Asian part of our collective inheritance, we can hardly question the necessity of overcoming the great ignorance about Asian peoples that prevails not only in Europe, the Americas, and Africa but also, to some extent, in Asia itself. Two facts of cultural history explain this ignorance. First, owing to Europe's domination of the globe from the eighteenth to the middle of the twentieth century, Asians had perforce to learn much more about Europe and even the Americas than Europeans and Americans felt they needed to know about Asia. Secondly, Asia itself, which stretches from Turkey east to Japan and from Siberia south to Sri Lanka, is so large and multitudinous that, historically, those who lived in one part of it knew little about those living in another. The Hall of Asian Peoples can, therefore, offer as much edification to an Asian as to a non-Asian.

May I now turn to the broad significance of cultural undertakings such as this exhibition. For the first time in history, the human race is coming to understand that it constitutes a single community and inhabits a world that is indivisible. All of us, of course, retain and take pride in our respective national and cultural identities. Over and above these affiliations, however, we have all become citizens of one world.

A certain amount of knowledge about the different peoples of the globe and their traditions should now be an essential part of the equipment for this citizenship. We now know more than ever before how human cultures have interacted and interpenetrated throughout history. In older times, before modern communications and the growth of a variety of academic disciplines, a person who studied two cultures would be absorbed by their differences. Now, without losing sight of the specific features of each, we are equally fascinated by their points of resemblance. To detect the parallels—the elements of correspondence—between different societies is an invigorating exercise. More important than that, this exercise serves to rid us of the influence of those myths of cultural superiority that give rise to ethnic prejudice and cultural arrogance.

We may be unhappy about much in our world today, but here is one fact at least that signifies real, undeniable progress: In our age there exists a far more sympathetic comprehension of the world's diverse societies, a greater respect for cultures and peoples different from one's own, than was ever the case before. This includes an interest in traditional ways of life unaffected by modern technology. Walls that separated cultures and inhibited their mutual understanding are steadily being dismantled. I feel that this broadening of sympathies, this liberation from prejudice, represents a great accomplishment of humanity that will help to make its future brighter than its past.

This is not only a moral and intellectual resource. It is a matter of great political consequence as well. This is apparent in numerous ways; I choose but one example. Let us compare the world of the United Nations with that of the colonial era. Colonialism was based on the assumption that civilization as such meant West-

"It looks like a fun-house mirror, but it gave Gulf a clear look at the future of solar energy."

"There's more to solar energy than the flat black solar collectors you see on the roofs of houses," says Staff Engineer Julien Reynaud. "For instance, this solar concentrator we developed here at General Atomic. It looks like a fun-house mirror, but it can heat flowing liquids to temperatures up to 1100°F.



"General Atomic is working hard to determine how much commercial power you can extract from sunlight."

"There are other technologies being developed by General Atomic, which is 50% owned by Gulf Oil, to make solar energy commercially practical. Our newest solar projects include a multiple-effect thin-film distillation process that can produce a lot of distilled water using low-grade heat sources; and polycrystalline photovoltaic cells for converting sunlight directly into electricity.

"There's still a long way to go. We'll be into the next century before sunlight supplies more than 5% of this country's total energy requirements. But there has been progress. Solar energy is already working in some factories, heating water, bleaching textiles, drying lumber.

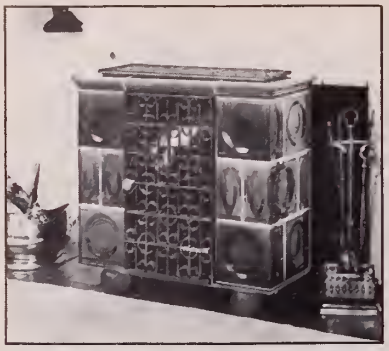
"Of course, solar energy works best where it's sunny, dry, and with almost no air pollution. But wherever it works, it frees up precious fossil fuels for use somewhere else.

"Gulf's research in solar energy is one part of our overall commitment to energy for tomorrow."

Gulf

Gulf people: energy for tomorrow.

Gulf Oil Corporation



Now, seven beautiful ways to keep warm

At last — a superbly efficient woodburning stove beautiful enough for your home. And now in your choice of seven decorator tile colors!

The WESO Ceramic Tile Stove employs both convection and radiant heat to surround you with gentle all-over warmth. The fire burns all night without tending — when the coals have finally died, the tiles continue releasing heat into your rooms.

The WESO burns both wood and coal and offers every efficiency feature you could ask for. It enhances the beauty of your home, where a black metal stove would be rudely out of place.

Enclosed is $1. Rush me your literature showing the WESO CERAMIC TILE STOVE in all 7 tile colors — plus details about WESO's new COALBURNING STOVE — and shipping schedule for winter delivery

Name _____

Address _____

_____ Zip _____

Ceramic Radiant Heat
2911 Pleasant Drive, Lockmere, N.H. 03252



ern civilization; other societies were regarded as civilized only to the degree that their systems or institutions approximated the Western pattern. In other words, the world was divided into civilized peoples and what were called "lesser breeds." We have come a long way from that kind of thinking—so long, in fact, that it is hard to believe that such prejudice prevailed until only a few decades ago.

One of the basic principles of the Charter of the United Nations is that of the sovereign equality of all members of the organization. This is not just an abstract principle; it is an operative fact governing the actual working of the different organs of the United Nations. What lies behind it is nothing short of a revolution in attitudes, political as well as cultural. Decolonization, the greatest development of our century, is a product of this revolution. The more we absorb all the implications of this change, the better will international understanding and cooperation grow and the greater will be our capacity to manage our problems.

This is not the occasion for me to talk about the world's problems. We all know that some of these problems are currently causing us a great deal of anxiety. I do not underestimate their gravity. Undoubtedly, we are passing through a very difficult phase of international relations. Our immediate problems relating to peace and security are, of course, a different matter; but as far as our long-range problems are concerned, there is a certain positive element in the very fact of their being listed on the world's agenda.

Their nature bears an essential relation to the understanding of the world and of peace that the United Nations has worked to promote. Take the problems of reducing poverty and ignorance in the world. We are addressing our attention to them because we consider peace to mean something larger and regard the world as more unified than people did before the United Nations was founded. If we did not believe—as we do—that peace is not stable unless it assures justice and secures progress for all, if we did not regard—as we do—our world as interdependent and therefore indivisible, we would not be concerned as much as we are, for example, by the delay in instituting a new international economic order. This does not mean

---

Dance Around the World

In a program geared especially for families, the Membership Office will present *A World of Dancing* with the Matteo EthnoAmerican Dance Theater on Sunday, January 18, at 2:00 P.M. in the Auditorium. Dances will include a comical mask dance from Japan, castanet dances from Spain, jigs and hornpipes from Ireland, and in a melding of East and West, a dance from India set to an American folk tune. Tickets are $1.00 for members, $4.00 for nonmembers. For ticket information call (212) 873–1327.

The Past Researched

The January Members' Program, *The Grand Canyon*, ties in with the Museum's current special exhibition, *Profiles of the Past*. Sidney Horenstein, curator of the exhibition, will use slides and film to discuss the natural history of the Grand Canyon, from its geologic past to the plants and animals that inhabit its rugged terrain today. The program will take place on Wednesday, January 21, at 7:30 P.M. in the Auditorium and is free for members; $3.50 for the general public.

Man and Nature

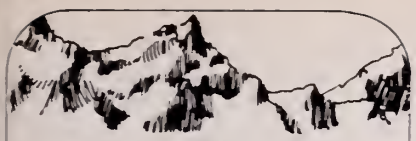
On the weekend of January 10 and 11, the Education Department is presenting a program of *Man and Nature Films*. Beginning at 2:00 P.M. in the Auditorium, three free films will be shown: *The Great Blue Heron, The Wolf and the Whitetail*, and *Last Stand in Eden*.

Workshops for Young People

January is registration time for the spring series of *Workshops for Young People*. Children in grades 4 to 7 can learn about the world of natural science through hands-on activities with Museum instructors in laboratories and in the field. Write the Department of Education for a brochure and application form.

Tribute to King

On Thursday, January 15, the Museum will celebrate the birthday of Martin Luther King, Jr. *La Rocque Bey Dancers and Drummers* will present a program of Caribbean music and dance, and other musicians will also perform during the evening. This free program begins at 7:00 P.M. in the Auditorium.



University of California, Santa Cruz

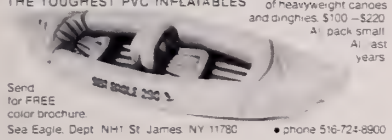
JOIN A WILDLANDS RESEARCH TEAM IN THE MOUNTAIN WEST

Wildlife teams include
Michael Hutchins' Mountain Goat Project
and 11 other project choices

SUMMER, 1981
Field Courses, 5 Units
Phone (408) 429-2822 or write:
WILDLANDS RESEARCH INSTITUTE
University of California Extension
Santa Cruz, CA 95064

SEA EAGLE
THE TOUGHEST PVC INFLATABLES

A new series of heavyweight canoes and dinghies. $100 – $220. All pack small. All last years.



Send for FREE color brochure.
Sea Eagle, Dept. NH1 St. James, NY 11780 • phone 516-724-8900

BOOKS PUBLISHED

National book publisher can print your book for as little as 18c per copy (paperback, 100,000 copies). For further info write: Regal Press Inc., 4501 N.E. 36th Street, Oklahoma City, Oklahoma 73121 or call (405) 424-3362.

TICKLE THE IVORIES!
PATENTED SYSTEM!



FASTEST, EASIEST PIANO COURSE IN HISTORY! FREE INFORMATION. CORRELATION MUSIC, BOX 751 A LA CANADA, CA 91011

English Countryside Walks

Through quaint villages and lovely scenery. Along mediaeval footpaths, prehistoric and Roman tracks . . . 18-day, 9- and 10-day tours . . . Relaxed pace . . . Small parties . . . Country inns . . .

Please send me further information:

Name _____

Address _____

_____

Country Walking Holidays

6195 Santa Clara Pl., Rohnert Park, CA 94928

that we are being merely idealistic. Our beliefs are grounded on facts; our perceptions are pragmatic; what we seek are real necessities. But it does not signify that the frustrations and anxieties we suffer are those that arise at a higher level of international life than was ever attained before. This is the level humanity has risen to; to descend from it is no longer a practical proposition.

As in our international political dealings, so in our study and observation we must keep the thought always in our minds that no nation is an island unto itself and that all the world's peoples are neighbors who need to learn much from one another. I trust that this largest collection of Asian artifacts ever assembled outside Asia will not only impress the millions who are going to see it with the beauty of Asian art and crafts and the long and richly varied heritage of Asian societies but will also help to nourish the sentiment that all of us belong to one human family. Besides being a source of great enjoyment and instruction, let this exhibition serve as an instrument for better international understanding and, in this way, help to promote the cause of peace.

WHEN YOU WRITE TO NATURAL HISTORY

about a change of address, renewal of subscription, billing, or any kind of adjustment, send the present address label from the magazine wrapper

Moving? Please notify 6 weeks in advance. You can use this form to tell us about a move or order a subscription.

Change of address—Attach your address label in the dotted area and fill in your new address below, clip and mail to Natural History Membership Services, P.O. Box 4300, Bergenfield, N.J. 07621

Cut your old address label from magazine wrapper and attach over this area. Fill in your NEW address and mail to: Natural History Magazine, Membership Services, P.O. Box 4300, Bergenfield, N.J. 07621

PLEASE PRINT

Name _____

New Address _____

City _____ State _____ Zip _____

Iceland Greenland

Cruising expeditions to Iceland / Greenland



Polar bears, walrus, exceptional birdlife, Eskimo villages, Norwegian fjords, Spitsbergen. Informative lectures by expert naturalists. Fine accommodation / cuisine on our MS WORLD DISCOVERER — the world's most sophisticated expedition ship. Rates from $4400. Departs July and August. Write for details.

Society Expeditions Cruises Inc.
723 Broadway E
Seattle, WA
98102 USA

Name _____

Street _____

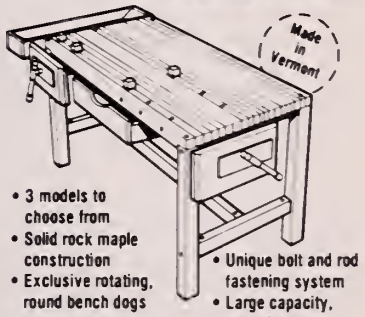
City State Zip Dept. NH1

Cruising expeditions also to: ☐ Amazon ☐ Antarctica ☐ New Guinea ☐ Indonesia ☐ Seychelles ☐ Red Sea ☐ Iceland / Greenland

M.S. World Discoverer Registered in Singapore

At Last!

Quality Designed Workbenches at Affordable Prices



- 3 models to choose from
- Solid rock maple construction
- Exclusive rotating, round bench dogs
- Sturdy laminated "Butcher Block" tops
- Unique bolt and rod fastening system
- Large capacity, precision vises
- Full one-year warranty

If you've been looking for a high quality work bench that is reasonably priced, Garden Way has a bench to suit your workshop and budget. Save by ordering direct from the factory. Write today for free details or call...

Toll Free 800-451-5088, ext. 56

©1980 Garden Way, Inc.

TO: Garden Way Research Dept. A792W Charlotte, VT. 05445

☐ **Yes!** Please send me free information on all 3 Garden Way Workbenches!

NAME _____
(Please print)

ADDRESS _____

CITY _____

STATE _____ ZIP _____

THE MARKET

Art

AMERICAN INDIAN CRAFTS: Pueblo pottery; Hopi 2nd and 3rd Mesa plaques; Kachinas, old and new rugs. No catalogue. One-of-a-kind pieces; individually photographed. Most priced $100/up. Write for photos and data, specifying interests. Box 5896, Sherman Oaks, CA 91413 (213) 789-2559

BEAUTIFUL MAI MUSEUM sponsored western and Indian original lithographs, free brochure: FAC, P.O. Box 292, Franklin Lakes, NJ 07417

CONTEMPORARY PHOTOGRAPHS—Signed Limited Editions. Kertesz, Levitt, others. B&W $90 to $900. Free brochure. Photographs For The Collector, Box 432HH, Chappaqua, NY 10514

EXCITING LASER PICTURES. Beautiful Framed Pictures of wildlife and scenic photos reproduced by quality Laser technology. Must see to appreciate lifelike color and clarity. Send $1.00 for color catalogue to Impact, 125J Mason Cir., Concord, CA 94520

FOUR HAND PRINTED SOUTHWESTERN SCENES. 11″ × 14″ B&W prints suitable for framing $20. Box 397, Vanderwagen, NM 87326

LOST ART REVISITED. Stained Glass Supply Catalogue, $2. Nervo Distributors, Dept. NH, 650 University, Berkeley, CA 94710

OUR NATIONAL PARKS IN FULL COLOR. Free illustrated brochure of large lithographs splendid for framing. Write Photo Classics, Box 11, Dickerson, MD 20753

Back Numbers

NATIONAL GEOGRAPHICS, 1888 - 1980, Issues, Book Publications, Collectors Items. Send Wants. Buxbaum Geographics, Box 465-NH, Wilmington, DE 19899

Book Publishers

PUBLISH YOUR BOOK! Join our successful authors. Publicity, advertising, beautiful books. All subjects invited. Send for fact-filled booklet and free manuscript report. Carlton Press, Dept. NHA, 84 Fifth Avenue, New York 10011

Books

BECOME A SPARETIME TRAVEL AGENT, detailed guidebook explains how, commissions, travel benefits, $3.95, SAV Travel, Box 571-NH, Hicksville, NY 11802

BOOKFINDING. Librarians search worldwide titles or subjects plus 150,000 indexed stock. PAB, 2918 Atlantic, Atlantic City, NJ 08401 (609) 344-1943

KIDSTUFF—A Handbook of Children's Crafts. 24 delightful projects written on a child's level professionally printed. $3.00 postpaid. Bethany Books, Box 434, Grand Coulee, WA 99133

HUMMINGBIRDING IS PLEASURABLE & REWARDING. "Attracting & Feeding Hummingbirds", 16 page booklet, $1.00 ppd. WoodsWorld Hummingbirding Society, 218 Buena Vista Avenue, Santa Cruz, CA 95062

LEARN HISTORICAL CORNHUSK CRAFT. Make dolls, decorations from natural, American husk. Send $10.95 to Corncraft Book, Box 562, Bethel Park, PA 15102

NATURAL HISTORY—Rare, some with color plates. Catalogue $1.00. Book Caravan, P.O. Box 72, Lake Wales, FL 33853 (813) 676-7035

OUT-OF-PRINT, SCARCE, Zoology, Botany, Ornithology, Colorplate, etc. Catalogue $1. Book Chest, 19 Oxford Place, Rockville Centre, NY 11570

PUBLISHERS' OVERSTOCKS, BARGAIN BOOKS 2,000 titles, all subjects! Free catalogue: Hamilton, 98-55 Clapboard, Danbury, CT 06810

TEACH YOURSELF STAINED GLASS, send $10 for 2 volumes to Stained Glass Primer, Dept. SGN, 10033 Broadway Terrace, Oakland, CA 94611

"TROPICA"—Cyclopedia of Exotic Plants, 7,000 color photos, 1,136 pages, $115. Request circular. Roehrs, Box 125, E. Rutherford, NJ 07073

WILDLIFE, BIRD REPTILE BOOKS, selected worldwide publications. Large descriptive catalogue 50¢. Zoo Books, Box 3, Hollywood, FL 33020

Camps

PRAIRIE TREK (Boys 13-17)—Turquoise Trail (Girls 13-17)—Little Outfit (Boys 10-12). Since 1926 these expeditions have made it possible for young people to explore in the mountains, canyons, and desert country of the American Southwest. Emphasis on environmental studies, archaeology, native crafts, backpacking and camping skills. For details write: Thomas M. Billings, P.O. Box 40451NH, Indianapolis, IN 46240 (317) 896-3842

Collectors' Items

GEMSTONES direct from cutter. Beautiful "starter" collection $10. Durand, 300 N. 4th (1414), St. Louis, MO 63102

Correspondence

MAKE FRIENDS WORLDWIDE through international correspondence. Illustrated brochure free! Hermes-Verlag, Box 110660/NH, D-1000 Berlin 11, West Germany

ORIENTAL WOMEN SEEK CORRESPONDENCE for cultural exchange, language practice, friendship. Asian Exchange, Honokaa, Hawaii 96727

Education

NONRESIDENTIAL UNIVERSITY DEGREES

Bachelors, Masters, Doctorates, for the accomplished individual. State-authorized, inexpensive, efficient. *Richard L. Crews, M.D., President*

COLUMBIA PACIFIC UNIVERSITY
150 Shoreline, Suite 8412 • Mill Valley, CA 94941
Call Toll Free USA: 800-227-1617, ext.480
California Only: 800-772-3545, ext. 480

AUDOBON ECOLOGY CAMPS offer outstanding educational experiences for Adults. Four exciting locations: fragrant woodlands in Connecticut, rocky seacoast in Maine: canoe country in northwest Wisconsin: Wind River Mountains in Wyoming. Have fun while learning in informal, friendly settings. Thrill in the exploration and excitement of discovery. Field trips aplenty with enthusiastic staff naturalists. Develop sense of individual responsibility for care and use of our natural resources. University credit optional. One- and two-week sessions depending on location. Mid-June into August. Write: National Audubon Society, Dept. NH, 950 Third Avenue, New York, NY 10022. COLLEGE AND HIGH SCHOOL students are also invited to inquire about Audubon's challenging year-round travel/study/campout B.S. and M.S. environmental degree programs and courses. Write Dept. AEI above address.

LEAVE & LEARN. University of California has foreign study programs for adults, summer 1981. Oxford University and University of Kent, Canterbury—30 courses; Greece—archaeology; Venice—art history; New Guinea/Melanesia—anthropology; Leningrad—literature, history. Write: International Dept. K-34, UC Extension, 2223 Fulton, Berkeley, CA 94720

Employment Opportunities

AUSTRALIA NEEDS YOU! Jobs! Paid Transportation! Newest handbook, $2.00 (guaranteed). Australian International Services, Box 19107-RM, Washington, DC 20036

AUSTRALIA—NEW ZEALAND NEED YOU! Big Pay! 50,000 jobs. Free transportation. Latest listings $2.00. Austco, Box 772, Cypress, CA 90630

AUSTRALIA . . . NEW ZEALAND WANT YOU! 17,500 Jobs! Paid Transportation! New Report! $2—Moneyback Guarantee! "Australia Commission," Department 894-C1, National Press Building, Washington, D.C. 20045

FREE DETAILS—OVERSEAS JOBS! All occupations! 68 countries. Paid fare. Computerized reports. Jobworld, Box 681, Cypress, CA 90630

JOBS OVERSEAS . . . (Including Alaska Gas Pipeline) Free Details. Global Employment, Box 808-NH, National City, CA 92050

OVERSEAS—ALL OCCUPATIONS! Worldwide Directory and complete information—$3.00. International Opportunities, Box 19107-RM, Washington, DC 20036

ROCKY MOUNTAIN EMPLOYMENT NEWSLETTER! Colorado, Idaho, Montana, Wyoming! Current openings—all occupations! Free details . . . Intermountain-4Y, 3506 Birch, Cheyenne, WY 82001

TEACHERS - ADMINISTRATORS: School, college job openings: USA, $5.95; Abroad, $5.95. Placement, sources USA, $4.95; Abroad, $4.95. EISF, Box 662, Newton, Massachusetts 02181

Financial

GET CASH GRANTS—from Government. (Never repay.) Also, cash loans available. All ages eligible. Complete information, $2 (refundable). Surplus Funds-NH, 1629 K St., Washington, D.C. 20006

Foreign Newspapers

WORLDWIDE ENGLISH NEWSPAPERS. 65 countries including Israel! Sampler: 5/$2.98. Free Brochure. Multinewspapers, Box DE-20A, Dana Point, CA 92629

Gourmet Interests

CHICKEN VEGETABLE SOUP. Great cold fighter! $1.00 & SASE, Rainbow Recipes, Box 865, Pacifica, CA 94044

CHILI BEAN SOUP for cold winter months. $1.00 SASE P.O. Box 777, Swannanoa, NC 28778

FINE HARDWOOD SPICE RACKS and glassware of unique design. Free brochure. SpiceRacket, Drawer NH1, 3379 S.E. Division, Portland, OR 97202

FOUR SUGARFREE RECIPES. Natural ingredients. Cookies, Bread, Candy. SASE $3.00, 507 E. Washington Blvd., Pasadena, CA 91104

LEFTOVER RICE? Make nutritious Rice Pizza in minutes. $1.00 SASE Mama Lena, Box 6647, Chicago, IL 60680

MINNESOTA WILD RICE. $6.00 per pound prepaid. 5 pound Minimum shipment. E.L. Floura, Blackduck, MN 56630

PICKLED PICKEREL: simple, savory sea food recipe. $1.00 SASE Box 164, Sand Lake, NY 12153

SHARE WITH US treasured Swedish Rye Bread recipe $1.00 SASE to: Grandma, 1112 West Third, Jamestown, NY 14701

Government Surplus

"GOVERNMENT SURPLUS DIRECTORY " Buy 500,000 items (including Jeeps) . . . low as 2¢ on dollar! Most complete information available-$2.00 Surplus Disposal, Box 19107-RM, Washington, DC 20036

SURPLUS JEEPS—$19.30!—CARS—$13.50!—650,000 Items!—Government Surplus—Most Comprehensive Directory Available Tells How, Where To Buy—Your Area—$2—Moneyback Guarantee—"Government Information Services," Dept. DC-1, Box 99249, San Francisco, CA 94109

SURPLUS LAND FROM $3.50/ACRE!—New Buyer's Guide shows how!—Vacation!—Investment!—$2 Moneyback guarantee! "Surplus Lands Bureau" 894-E1 National Press Building, Washington, DC 20045

Merchandise

"I LIKE IT WILD® . . . " Wilderness/wildlife posters, T-shirts, notecards. Send stamped envelope: Wilderness Dreams®, Box 4455-N, Shawnee Mission, KS 66204

PURCHASE BOWIE, Civil War knives, Indian tomahawks. Robert Abels, 2881 N.E. 33 Court, Fort Lauderdale, FL 33306

UNIQUE SEED CATALOGUE, a practical growing-use guide to over 150 varieties; Herbs, Medicinals, Insect Repellent Useful Plants $1.00. Catalogue plus 4 seed pkts. Balm, Camomille, Peppermint, Pennyroyal $3.00. Naturalist, P.O. Box 435-N2 Yorktown Heights, NY 10598

Photo/Optical

BINOCULAR SALES AND SERVICE. Repairing binoculars since 1923. Alignment performed on our U.S. Navy collimator. Free catalogue and our article "Know Your Binoculars," published in Audubon Magazine. Mirakel Optical Co., Inc., 331 Mansion St., West Coxsackie, NY 12192 (518) 731-2610

HUGE DISCOUNTS. Nationally Advertised Brands. Binoculars, Spotting Scopes. Orders shipped prepaid. Free price list. Sandan Associates, Box 986, Delray Beach, FL 33444

WOLF PHOTOS FROM $1; slides 75¢; postcards 15¢. Free lists. J. Lidle, P.O. Box 112, Clifton Heights, PA 19018

Real Estate

FREE . . . 296-PAGE CATALOGUE. Describes and pictures over 2,800 farms, ranches, acreages, businesses and town and country homes from coast to coast. United Farm Agency, Inc., 612-V W. 47th St., Kansas City, MO 64112. Ph. Toll-Free: 1-800-821-2599; MO. Res. Ph. Toll-Free: 1-800-892-5785

GOVERNMENT LANDS . . . FROM $7.50/ACRE! Homesites, farming, vacationing, investment opportunities! "Government Land Buyer's Guide" plus nationwide listings—$2.00. Surplus Lands, Box 19107-RM, Washington, DC 20036

NEW! FREE! Big Spring Catalogue! Over 5,400 country properties described, pictured! Land, Farms, Homes, Businesses, Recreation, Retirement buys! Selected best thruout the U.S. Over 700 offices, 43 states All Across America! Yours Free from the World's Largest! Strout Realty, Inc., 60 E. 42nd Street, Dept. 5390, New York, NY 10017

Recordings

OLD TIME RADIO PROGRAMS on cassette tapes. Free catalogue. Cassette Library Center, P.O. Box 5331H, Baltimore, MD 21209

RECORDS—TAPES! Discounts to 73%; all labels, no purchase obligations; newsletter; discount divident certificates; 100% guarantees. Free details. Discount Music Club, 650 Main St., Dept. 25-0181, New Rochelle, NY 10801

Rentals

ADIRONDACK LODGES on Upper Saranac Lake. Available for two weeks or a month, July through September. Everything provided for comfortable living in the quiet woods. From $650–$1,700 for two weeks. Please write Bartlett Carry Club, RFD 3, Tupper Lake, NY

GULFRONT EXECUTIVE HOUSE: Dunedin, Florida. Newly furnished, pool, dock. Beaches, Golf nearby. $1250.00 month. (313) 358-2274

VACATION RENTAL HAWAII BEACHFRONT ESTATE. Executive 3 bedroom, 2 bath home 1½ acres. Includes car/maid. All amenities. $840/week. (808) 946-9939

Resorts

LITTLE ST. SIMONS ISLAND

One of Georgia's "Golden Isles"



Birding, beachcombing, riding, wildlife photography, fishing or just relaxing on a secluded 12,000 acre island with miles of unspoiled ocean beaches, forests and marshes. Over 200 species of birds. Maximum of 10-15 guests at a time. Excellent food and accommodations. Professional naturalists on the staff. **Little St. Simons Island** P.O. Box 1096N, St. Simons Island, GA 31522

BELIZE—RUM POINT INN, Placencia. Personalized vacation maximum 8; snorkle largest reef in hemisphere; visit unfrequented Mayan Ruins; experience other cultures while enjoying private seaside cabins, interesting cuisine. Write 3526 Old Onslow Road, Greensboro, NC 27407

IDAHO WILDERNESS. Small family homestead on beautiful Selway River. No roads. Access by horseback along historic Nez Perce Trail. Comfortable cabin accommodations, home-style meals, fishing, riding, hiking, rafting. Two weeks (minimum)—$690. Selway Lodge, Box 1100-H, Hamilton, MT 59840

MAINE: Remote fly-in XC ski lodge. Outstanding backcountry touring, beginner to expert. Warm comfortable cabins, excellent food, sauna, maximum 10 guests. Little Lyford, Brownville, ME 04414

SKIFFLES VILLAS, Anguilla, West Indies, unspoiled island, pool, beautiful beaches, luxurious, (219) 533-0461, 614 East Purl Street, Goshen, IN 46526

VACATION/RELAXATION—Birdwatcher's delight—Peaceful, secluded nature lover's mountain retreat. Cave Creek Ranch, Portal, Arizona 85632

Tours/Trips

ADVENTURES—Observe whales in Baja Lagoons and off Maui, Hawaii. Photograph Polar Bears & Beluga Whales in Canadian Arctic. Wildlife adventures to South America, Galapagos, Kenya, Tanzania, Zambia & Zaire. Expeditions to New Zealand, Australia and the Himalayas. 1981 trip preview available. Adventures International, 4421N Albert, Oakland, CA 94619

ALPS OF SWITZERLAND DAY HIKING—Two or four week tours. Brochure. Alpine Adventure Trails Tours 783C Cliffside Drive, Akron, OH 44314

AMAZONIAN ADVENTURES: EXPLORER'S INN. Incomparable Avifauna (Peru: 1,700 recorded species). Various programs, optionally combining Peru, Ecuador, or Galapagos. Forum Travel International, 2437 Durant, Berkeley, CA 94704 (415) 843-8294



Italia Adagio

THE MOST BEAUTIFUL TOURS OF ITALY EVER CREATED Designed and directed by the American painter, Frieda Yamins, for the discerning traveler who enjoys the diversity of Italian culture, the luxury of castle hotels, and the fine Italian art of exuberant dining!

Detailed Brochure Available from

23 days—Land Arrangements $2590 plus air fare. Departures April, May, June, September, October 1981

Italia Adagio 162 F Whaley Street Freeport, New York 11520 (516) 868 7825

BACKPACK THE ALLEGHENY, for single hikers, $313, July 10-14, 1981. Also sailing, birding trips. Blue Sky Adventures, Dept. NH2, Oak Ridge, NJ 07438

BACKPACKING, Ski-Touring and Bicycle Touring with Wilderness Trails. Come hike the River of No Return Wilderness, ski the Payette River Mountains or bike along the Salmon River. Trips for all abilities, everything provided. We have thirteen years of experience and guide only in Idaho. Write Wilderness Trails, P.O. Box 9252M, Moscow, Idaho 83843 (208) 882-1955

BED & BREAKFAST IN NYC. Visiting NYC? Lovely, comfortable rooms, fine locations with host families. Urban Ventures, 322 CPW, NYC 10025 (212) 662-1234

CANOE ARCTIC. Fly-in canoe expeditions into the heart of North America's last great wilderness—the tundra and taiga of Canada's Northwest Territories. Discover the warm dry summers, spectacular scenery, and unparalleled wildlife concentrations of a land untouched by man. Photograph caribou herds, white wolves, muskox, moose, grizzlies, rich birdlife. Virgin fishing. Groups of 6 or 8 persons assembled and guided by Alex Hall, wildlife biologist and veteran arctic canoeing guide. All food and equipment provided. Can accommodate a limited number with no previous canoeing experience. Two-way radio. 12 days from $1210; 18 days from $1570. For brochure write: Canoe Arctic Inc., Box 130(C), Fort Smith, N.W.T., Canada X0E 0P0

GALAPAGOS AND INCA PERU. The trip of a lifetime. A small group tour offering individual attention. Two departures for two weeks each: February 4 and August 12. Cost $2,698 U.S. per person. Limited space available. For further information contact: Wings of the World, Inc. Travel, 653 Mt. Pleasant Road, Toronto, Canada (416) 482-1223

GALAPAGOS: For the best Galapagos experience, hike and sail the Islands with our small groups. Peru—Machu Picchu options and horseback expeditions. Inca Floats, 5982 N. Balboa, Oakland, CA 94611 (415) 339-9095

HIKE THE SWISS ALPS. Swissair flies you to special hiking tours, led by popular author/mountaineer Fred Jacobson: Zermatt, Saas-Fee, Lenk, Kandersteg, Pontresina. Beautiful and challenging trails. Delightful country inns. Superb cuisine. 9th summer! Write Fred Jacobson, Dept. NH1, Chappaqua Travel, 24 S. Greeley Avenue, Chappaqua, NY 10514

HIMALAYAN TRAVEL, INC. Trekking expeditions in the Everest and Annapurna areas of Nepal. Exotic cultures/spectacular mountain scenery. Box 481-NH, Greenwich, CT 06830 Toll Free (800) 243-5330

MAINE WINDJAMMER VACATION, August 16-22, 1981, $360, reservation deadline 2/15/81. New Jersey Audubon Society, 790 Ewing Avenue, Dept. NH, Franklin Lake, NJ 07417

NATURALIST GUIDED FIELD SEMINARS and tours, West Texas and Mexico. Rafting, hiking, backpacking, bus. University or Continuing Education credit as appropriate. Write Education Department, Chihuahuan Desert Research Institute, Box 1334, Alpine, TX 79830

NEW MEXICO. Guided tours—wildflowers, birds, prehistoric dwellings. Bear Mountain Ranch, Silver City, NM 88061 (505) 538-2538

NORTH SCOTLAND: HIGHLAND WILDERNESS. Explore, study, interpret the wildlife, vegetation, terrains & impact of man on a surpassingly beautiful land. Small group led by local Scot who knows surfaces & depths of his home place. 7-14 day programs, Apr. thru Oct. Details: Albannach Ltd., Hamilton House, Ross & Cromarty, Strathpeffer, Scotland

OAXACA, MEXICO. Unique historical/cultural tour. Mixtec, Zapotec pyramids/civilizations. Fabulous climate, villa, cuisine, festivals. $350 week. Oaxaca Club: (415) 388-3503.

SAIL PRINCE WILLIAM SOUND: Guided flotilla cruises. Lessons available. Whale observation. Nature Study. College credit. Alaskan Wilderness Sailing Safaris, Box 701N, Whittier, Alaska 99693 (907) 277-0160

SCOTLAND, ORKNEY, SHETLAND AND ICELAND. Comprehensive program of nature trips. Write: Caledonian Wildlife at McGregor Travel, 33 Lewis Street, Greenwich, CT 06830, or toll-free: (800) 243-5330

32nd ARCHITECTURE AND GARDENS tour of Japan. 22 days in-depth tour, leave October 9, Membership limited. Write: Escort-lecturer, K.M. Nishimoto, AIA, 30 North Raymond Avenue, Pasadena, CA 91103

TRAVELEARN, SUMMER 1981. Cultural-natural historical tours to Africa, Hawaii, China, and Greece led by specialists in the fields of study encompassed within each program. Office of International Studies, Kean College of NJ, Morris Avenue, Union, NJ 07083—Phone (201) 527-2461

WASHINGTON WILDFLOWER SAFARIS to Cascades and Olympics with professional naturalist. Brad's Tours, 401 E. Mercer #31D, Seattle, WA 98102

RATE AND STYLE INFORMATION

$1.75 per word; 16 word ($28) minimum. *Display classified* is $150 per inch. All advertisements must be prepaid. Rates are not structured for agency or frequency discounts. All advertisements are accepted at NATURAL HISTORY's discretion. Send check/money order payable to NATURAL HISTORY to: The Market, NATURAL HISTORY Magazine, Central Park West at 79th St., New York, NY 10024. Please include your personal address and telephone number, issue preferred, and suggested heading. Deadline—8th of month, two months prior to cover date (the January issue closes Nov. 8). Camera-ready art is required for display ads. A tearsheet or copy of the page with your ad will be sent upon publication.

Box numbers, telephone numbers, and hyphenated words count as two words; abbreviations and zip codes as one word each. All states are shown in two-letter code followed by zip, then telephone (with area code), if desired. Occasionally, slight editing is required for clarity. Thank you!

Divine Plants

by Peter T. Furst

THE WONDROUS MUSHROOM, by R. Gordon Wasson. *McGraw-Hill Book Company, $14.95; 229 pp., illus.*
PLANTS OF THE GODS, by Richard Evans Schultes and Albert Hofmann. *McGraw-Hill Book Company, $34.95; 192 pp., illus.*

Two books by leaders in the study of plant hallucinogens have appeared within a few months of each other. One, by R. Gordon Wasson, gives us the first in-depth treatment of the sacred mushrooms of Indian Mexico and their cultural ramifications; the other, by Richard Evans Schultes and Albert Hofmann, covers the botany, history, ethnology, and biochemistry of the world's major psychoactive flora. All three writers have been associated for many years in common or parallel pursuit of a cultural phenomenon that we now know has respectable antiquity, reaching back thousands of years into prehistory, with wide geographical distribution (but centered on Middle and South America) and important implications for contemporary Western science and society.

Wasson is the pioneer ethnomycologist whose painstaking search for the identity of the ancient Indo-European plant deity *Soma* led him to *Amanita muscaria*, the sacred, inebriating fly agaric mushroom of Siberian shamanism and European folklore, an identification accepted by many, though not all, Vedic scholars. Schultes, Paul C. Mangelsdorf Professor of Natural Sciences at Harvard and long-time director of the Harvard Botanical Museum, forty years ago documented the divine Aztec hallucinogen *ololiuqui* as the seeds of the morning glory and has since made innumerable contributions to our knowledge and understanding of the rich psychoactive flora of the New World. Hofmann, coauthor of this work, is best known as the discoverer of LSD-25. But we are also indebted to him for the identification of the active compounds in the Mexican sacred mushrooms, the morning glories, and some other plants that Mexican Indians are certain possess the attributes of divinity. Not surprisingly, Wasson and Schultes played important roles in the direction of Hofmann's research in this area of chemistry; indeed, it was Wasson who collected sufficient seeds from two species of Mexican morning glories to allow Hofmann to bring his work to a successful conclusion. In 1960 he announced his startling discovery that the principal psychoactive compounds in morning glory seeds were nothing other than lysergic acid alkaloids, closely allied to his own synthetic LSD-25. It was the first time that such compounds had been identified in one of the higher plants, having been previously found only in such lowly fungi as ergot.

From morning glory seeds to the analysis of the magic fungi known to the Aztecs as *teonanácatl*, "flesh of the gods," was but a small step. Wasson again was the catalyst, but it was the famous French scholar Roger Heim who in his Paris laboratory succeeded in propagating specimens of Oaxacan mushrooms from which Hofmann isolated, for the first time, the natural agents chiefly responsible for their extraordinary psychic effects.

The Mexican "cult" of sacred mushrooms was first described by Spanish chroniclers in the sixteenth century. In the early twentieth century, William A. Safford, a leading U.S. botanist, rejected the story as implausible, suggesting that the Spaniards and their Aztec informants must have been talking of peyote, not mushrooms. (He also doubted the existence of hallucinogenic morning glories.) But in the late 1930s, several eyewitness accounts by reliable observers—the young Schultes among them—confirmed the veracity of the old reports that they were indeed mushrooms. The general public, however, remained unaware of all this un-

til Wasson described his own extraordinary experience as a participant in a divinatory rite involving the consumption of the sacred mushroom in the village of Huautla de Jiménez in the May 13, 1957, issue of *Life*. The article, unfortunately, resulted in a veritable invasion of the Indian highlands by seekers of instant nirvana through chemistry. Wasson has since written many times of the event, which he characterized as soul shattering and which totally reversed what he now recognized as culturally conditioned hostility to the fungal kingdom, especially its psychoactive members. In 1974 he published *María Sabina and Her Mazatec Mushroom Velada* (see review in *Natural History*, December 1975), a tour de force of modern ethnography. This book contained the complete text in Mazatec, Spanish, and English of María's prayer chants, part Christian but mainly native in origin, and her consultation, bemushroomed, with the sacred plant whose voice she, her patient, and the other Indian participants took to be that of Christ. Included with that remarkable book were four cassettes made from the original recording. Part of Wasson's new work is devoted to the 1955 experience, but his retelling is enriched by a fresh interpretation of the role of sacred mushrooms in Mesoamerican cultural history before and since the Spanish conquest. Along with Wasson I deplore the odd lack of response from anthropologists to his contribution, which to me seems crucial to understanding Native Middle American religion and the shamanic phenomenon as it survives in Mexico.

The book contains an analysis of the plant symbols carved on the famous statue of the Aztec god of flowers and rapture, Xochipilli, in Mexico City's National Museum of Anthropology. Schultes helped Wasson identify these plants, every one of which turned out to be one of the ritual intoxicants used by Mexican Indians, including tobacco, morning glory, *Heimia salicifolia*, sacred mushrooms, and possibly *poyomatli*, the flowers of a tree native to Veracruz and Oaxaca that were so highly esteemed by the Aztecs that they imported them over long distances.

Wasson's elucidation of the real meaning of the magnificent Aztec statue breaks entirely new ground in Aztec cultural history. Clearly the mushroom motif is central to the understanding of the god and of important aspects of Aztec religion. The mushroom motif is repeated on the deity's knees, the right forearm, the top of the head, and very prominently, on the base on which he is seated in a pose that suggests rapture, or ecstatic trance. Xochipilli, then, is more than the god of merriment and flowers—he is Lord of the "Flowery Dream," as the Aztecs so aptly called the ecstatic trance experience with the sacred psychoactive plants.

Some ten years ago, my own iconographic studies of hallucinogens in pre-Columbian art led me (also with the help of Schultes) to the identification of the morning glory, *Turbina corymbosa*, in the mural art of Teotihuacán, specifically at Tepantitla, but in the past I have been doubtful of Wasson's insistence of the presence there of sacred mushrooms. Now I am no longer so dubious—his case in this book for the mushroom in the murals and on some painted polychrome Teotihuacán pottery is much stronger than I originally supposed. But—and this is an important point—if what Wasson believes to be mushrooms really *are* mushrooms, they contain a significant message for the viewer. For they are all shown, not from above or in profile as they are elsewhere, but from below, featuring the juncture of the stem and the ribbed underside of the cap. Are we meant to see the mushrooms—as did the Indians' divine progenitors (or alter egos)—as the deities of earth and un-

A Taste of India
with
Nepal-Sri Lanka-Bhutan
Burma-Thailand

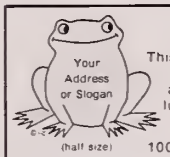
Journeyworld offers you the architectural splendours and unforgettable sights of some of the world's most creative civilisations.

You will see the Taj Mahal, Kathmandu in the Himalayas, the stupendous rock carved temples of Ajanta & Ellora, Bhutan a fairy tale Buddhist kingdom, colorful Kandy in Sri Lanka the glory of Pagan and Mandalay, the elephant camps and tribal villages of Chieng Mai.

The programs include comprehensive sightseeing, deluxe hotels and all meals.

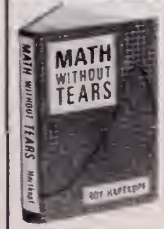
For brochures write to:

JOURNEYWORLD INT'L LTD.
155 EAST 55th STREET
NEW YORK, N Y 10022
TEL (212) 752-8308



FROG Stickers
This Happy Green Frog, printed with your name and address or slogan, adds a little fun to letters, books, luggage, toys, promotions....
Frog Shape...Self-Stick
100 for $6.50 or 200 for $9.20 ppd.
FROGS. Box 735-T, Acton, Mass. 01720

Crossroads of Evolution
Galapagos
Cruise Darwin's "enchanted island" by private yacht. Photograph unusual wildlife. Enjoy stimulating lectures by naturalist/guides. Visit artistic Cuenca on mainland Ecuador. 15 days.
Write for
Society Expeditions
Dept. NH-1
723 Broadway East,
Seattle, WA 98102
Name
Street
City / State / Zip
Please Include: ☐ New Guinea ☐ Patagonia ☐ Easter Island ☐ Galapagos ☐ Mongolia ☐ Tunisia ☐ Antarctica ☐ Amazon ☐ New Guinea & Melanesia ☐ New Guinea & Indonesia ☐ Singapore to Seychelles ☐ Seychelles to Red Sea ☐ Iceland & Greenland ☐ N. & West Africa ☐ China

MATH WITHOUT TEARS


Using non-technical language and a light touch Roy Hartkopf gives you a basic understanding of many everyday applications of mathematics. He takes the reader from simple counting to trigonometry and calculus, emphasizing the practical aspects of math. Humorously written.
Learn math in the comfort of your own home at minimum cost.
Order Now: $9.95 plus 95¢ hdlg.
EMERSON BOOKS, INC.
Dept. [illegible] Buchanan, N Y 10511
10 Day Money Back Guarantee



FROST-FIGHTER

Our Ragg Knit Balaclava is a favorite of backpackers, climbers, cross-country skiers and foulweather sailors. Rolled down it protects ears, forehead, neck and chin from cold; or wear it rolled up like a watch cap. The small visor shields your eyes. Ragg knit of 85% wool with natural lanolin to shed water and 15% nylon for strength. One size fits all. **Color:** Salt & Pepper. **Ragg Knit Balaclava $7.50** ppd.

Order Today! Money Back Guarantee!

Enclosed is my check or money order for $ _____
(Add sales tax where applicable.)

Please RUSH my **#1994 Ragg Knit Balaclava.**

Name _____

Address _____

City _____

State _____ Zip _____

☐ **Send me your FREE color catalog of quality outdoor apparel and equipment.**

Eddie Bauer®

Dept. 8N2, Fifth & Union, Seattle, WA 98124

Floating Through Europe



The original gourmet waterway cruises. Live and dine luxuriously aboard your barge-hotel. Seven days in another world.

Floating Through Europe Inc.
501 Madison Ave., New York, N.Y. 10022

See your travel agent or return this coupon today—for our 1981 brochure.

NAME _____

STREET _____

CITY _____

STATE _____ ZIP _____

128-0181

derworld? Can this help us to identify the specific locale of the scenes in the murals: just which level of the multitiered Mesoamerican universe is being depicted here? If so, the mushroom motif, almost by itself, reveals the murals' subject matter to be the underworld, fertile womb of the maternal earth from whence originate moisture and fertility.

Wasson concludes his exploration with an overview of the historical record, from the time of the conquistadors to the present. He also gives us the most thorough discussion to date of the famous "mushroom stones" of highland Guatemala and Mexico and their relationship to the ancient use of the sacred fungi as early as the mid-first millennium B.C., a functional connection most authorities now accept. He is, however, more impressed than I with published arguments for a connection between the mushroom effigies and the sacred ball game. These stone replicas may have played some role in the game—really a religious ritual—but I doubt that any were ever used to mold hollow rubber balls. In fact, all the descriptions of the game, and all the archeological finds, demonstrate unequivocally that the rubber balls were solid, never hollow, and so heavy that the chroniclers speak of serious injuries if a player was hit in a sensitive part. But these are minor flaws in a work whose flights of intuition are generally informed by painstaking scholarship.

Wasson's advocacy of a recently coined term, "entheogen" (God within us), in place of the more popular, but value-laden, "hallucinogen," because entheogen more nearly approximates "the rich cultural resonances evoked by the substances," is nicely complemented by the title of Schultes's and Hofmann's *Plants of the Gods*. This is a truly encyclopedic examination of the psychoactive flora of the world, profusely illustrated on every page in black and white and with more than a hundred color plates. There are introductory chapters on the definition of plant hallucinogens and their place in the plant kingdom, phytochemical research to date on sacred intoxicating species, geographical and botanical distribution and use (with a very clear map), and a most useful 29-page illustrated plant lexicon covering no fewer than ninety-one species with known or presumed psychoactive properties. This is followed by specific discussions of fourteen major Old and

☐ FISHING
☐ WILDLIFE
☐ ESKIMO CULTURE

ARCTIC

SPECIAL INTEREST TOURS

P.O. BOX 37-N
MEDINA, WA 98039

More Birds in Your Yard or your money back!

Thistle Seed Feeder attracts finches, chickadees, nuthatches. Send $10.50 PPD.

Write for FREE Catalog today.

The Bird Tree
5 Swallow Lane, Dept 84
St Paul, MN 55110



Easy-to-install

FREE 1 lb. Thistle Seed with each feeder.

international nature tours

Galapagos Islands/ Headwaters of the Amazon/Ecuador/ Peru/Patagonia/ Falkland Is./Kenya Tanzania/Rwanda Gorilla Safari/Costa Rica/Nepal/New Guinea

Expert Naturalist Guides
Very Small Groups



Write: **WILDERNESS TRAVEL***
1760-NJ Solano Ave., Berkeley, CA 94707
(415) 524-5111
*formerly *So. American Wilderness Adventures*

WHEN YOU WRITE TO NATURAL HISTORY

about a subscription renewal, billing, or any kind of adjustment, please include your present address label.

Moving? Please notify 6 weeks in advance. Send your present address label along with your new address to Natural History Membership Services, Box 4300, Bergenfield, NJ 07621.

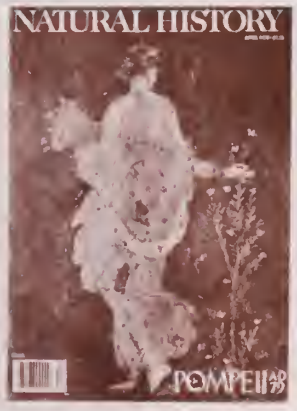
Name _____

New Address _____

_____

City _____ State _____ ZIP _____

Please Print **Attach Label**



Send gift subscription to:

Name

Street Address

City State Zip

I prefer to give: ☐ 2 years at $26 ☐ 3 years at $35

YES, I want it all.

Please enter my subscription to NATURAL HISTORY Magazine for one full year.

Bill me just $15 as dues for a year's membership in the American Museum of Natural History, which includes this subscription and other benefits—among them free admission to the museum, discounts on books and artifacts, travel opportunities, and priority tickets for special events. Send my Membership Card and magazines to:

J461

Name

Street Address

City State Zip

☐ Payment enclosed ☐ Bill me ☐ New ☐ Renewal

I prefer: ☐ 2 years at $26 ☐ 3 years at $35

NATURAL HISTORY Magazine is published by the American Museum of Natural History, New York, N.Y. Please allow 7 weeks for first copy. Outside U.S. please add $3 per year for postage.



NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO. 30 BERGENFIELD, NJ

POSTAGE WILL BE PAID BY ADDRESSEE

NATURAL HISTORY

P.O. Box 4200
Bergenfield, N.J. 07621

New World species and their cultural roles. The lexicon is ordered alphabetically by genus name, and all have fine color illustrations, mostly hand-drawn but a few photographic, to facilitate identification in the field. A word of caution (which the publishers might have displayed more prominently): although most hallucinogenic plants are neither habit forming nor have lasting detrimental effects on the body, a few can be dangerous if ingested (*Datura*, for example, and some members of the Leguminosae, such as *Sophora secundiflora* of the "Red Bean Cult" of the Southern Plains Indians). Also, neophytes may find it difficult to distinguish some entheogenic mushroom species from highly toxic ones.

The lexicon is followed by a brief discussion of users of hallucinogenic flora and a convenient fifteen-page overview of plant use and effects, facilitating the confirmation or contradiction of claims made for a particular species. The section dealing with the fourteen major hallucinogenic plants properly leads off with a discussion of *Amanita muscaria*, whose use by shamans of the Eurasian forest belt may predate the early peopling of the Americas by hunters migrating from northeastern Asia, who may have arrived here prepared for a search of the environment for species with similar psychic effects.

In other chapters, the book deals with the "hexing herbs," particularly henbane, mandrake, and belladonna, which became famous in Europe in the Middle Ages; with *Cannabis*, a hardy multipurpose genus of Asian origin introduced into the Americas after the conquest and long exploited not only for its psychotropic properties but for its economic, nutritional, and medicinal values (most recently in the treatment of glaucoma and of the extreme nausea that accompanies chemotherapy); and with the curious ergot (*Claviceps purpurea*), a fungal blight of Old World rye grasses responsible for many of the bizarre epidemics of hallucinations and poisonings, often fatal, that swept Europe in the Middle Ages and, less certainly, for the sublime ecstatic experience known as the Eleusinian mysteries of ancient Greece.

Among the many other plants covered in subsequent chapters is peyote, which has a natural range restricted to north-central Mexico and the Rio Grande valley of Texas, but whose use as a sacrament by some 250,000 Indian adherents of the Native American Church, from the Mexican border to the Canadian Plains, makes it the most widely used entheogen of all.

Schultes's career as the ranking authority on New World hallucinogens began, in fact, with peyote. His introduction to the ethnobotany of hallucinogens dates back to 1936, when, as a senior in biology at Harvard, he accompanied Weston La Barre, then a doctoral candidate in anthropology at Yale, to the Kiowa Reservation in Oklahoma to study the nature and culture of peyote. The peyote chapter draws heavily on accounts and illustrations of its use among the Huichol Indians of Mexico and by Native American members of the so-called peyote church.

A final chapter deals with some recent medical applications of hallucinogens, particularly LSD in the psychotherapeutic treatment of terminal cancer patients, to free them from the fear of death and, to some degree, from the perception (although not the reality) of pain. This chapter presumably had some contributions from Joan Halifax, a medical anthropologist with direct experience in such treatment, who researched and wrote many of the captions and also participated in the conception and design of the book.

With respect to captions, the deity depicted with the stylized morning glory plant in the Tepantitla mural on pages 160–61 is, of course, not an "Aztec Mother Goddess," but a mother goddess of the people of Teotihuacán, inasmuch as the mural dates from the early to mid-first millennium A.D., the height of the great Teotihuacán civilization. The Aztecs did not arrive in the Valley of Mexico until the thirteenth century A.D., centuries after Teotihuacán had been abandoned and had fallen into ruin. Finally, notwithstanding the unquestioned authority of Schultes and Hofmann, one misses footnotes; the identification of sources other than their own research would not have detracted from this handsome and valuable, if (understandably) expensive, addition to the literature. For the sake of my students, I hope for an early paperback version.

Peter T. Furst is professor of anthropology at the State University of New York at Albany and author of the books Flesh of the Gods *and* Hallucinogens and Culture.

Join Us in the Grandest Adventure of All



Now you can join some 50,000 adventurers who subscribe to ARCHAEOLOGY. In the 1980s, you will visit "digs" from Australia to South America, from Alaska to the Far East and everywhere in between. On these round-the-world journeys of exploration, you will have professional archaeologists as your guides—men and women intimately involved with the projects, writing in a clear, concise, easy-to-read manner. Through the many magnificent full-color photographs, your home will become a veritable gallery of the most exquisite art and artifacts of the past.

- Visiting Archaeological Sites—A twice-a-year feature that brings you news of actual archaeological sites that welcome visitors, both in North America and around the world. Included are dates and hours, what to look for, how to get there, whether accommodations are available and who to write for further information.
- Archaeology News—Important excavations and newly-discovered objects worldwide, as well as reviews of exhibitions.
- Current Exhibitions—What to see in museums in North America and abroad.
- Archaeology Passport—Archaeological tours for the world traveler.
- Archaeology Films, The Bookshelf, and New Books—Reviews of important new films and books, plus a listing of new books received.
- Words to Remember—An ongoing dictionary of Archaeological terms.

ARCHAEOLOGY
Dept. 8203 P.O. Box 385
Martinsville N.J. 08836

☐ One Year (6 issues) of ARCHAEOLOGY for $15. (I save $3 under what others pay on the newsstand.)
☐ Two Years (12 issues) for $27. (I save $9 or 25%)

If not absolutely satisfied with the first issue, I may write "cancel" on your bill and owe nothing (or receive a full refund if I enclosed payment with this order).

☐ Payment enclosed. ☐ Bill me later
☐ Check here if this is a renewal.

Add $3 per subscription year for foreign or Canadian postage. Please allow up to 8 weeks for delivery of your first issue.

NAME _____
ADDRESS _____
CITY _____
STATE _____ ZIP _____
Name on gift card _____

Additional Reading

British Museum (p. 38)

An account of the life of John Edward Gray (1800–1875) and Albert Gunther (1830–1914), A. E. Gunther's *A Century of Zoology at the British Museum Through the Lives of Two Keepers* (London: William Dawson and Sons Ltd., 1975) is also a record of zoology and natural history in the late nineteenth century, ending with a chapter on "The Problem of Darwinism." G.R. DeBeer's *Sir Hans Sloane and the British Museum* (New York: Arno Press, 1975) is a detailed biography of the physician, naturalist, and great collector. *The Life of Richard Owen* (London: Gregg International, 1970) is a biography of the famous naturalist written by his grandson, Rev. R. Owen. Originally published in two volumes in 1895, this book includes an essay by T.H. Huxley, "Owen's Position in the History of Anatomical Science." According to author J.M. Cook, his illustrated essay, *The British Museum* (New York: Praeger Publishers, 1972), is "a case study in aesthetic politics" and an attempt to "explain the relation between the British Museum as an institution and the British Museum as a piece of architecture." Cook describes E. Edward's *Lives of the Founders of the British Museum* (New York: B. Franklin, 1969, reprint of the 1870 edition) as "a mine of information" that is "ponderous but invaluable." In his introduction to *The Journal of a Disappointed Man*, by W.N.P. Barbellion (New York: George H. Doran Co., 1919), H.G. Wells called it "the diary of an intensely egotistical young naturalist," whose many accomplishments included securing an assistantship at the British Museum (Natural History). J.S. Weiner's *The Piltdown Forgery* (Oxford: Oxford University Press, 1955) covers an important segment of the British Museum's history. Since its advent, the museum has published and revised a number of scientific papers, guides to the departments and exhibitions, and handbooks. From 1927 to 1936, the museum published *The Natural History Magazine.*

Acadians (p. 48)

The Cajuns: Essays on Their History and Culture, edited by G. Conrad (Baton Rouge: The Lafayette Press and Center for Louisiana Studies, 1978), is a major collection of essays on Acadian life. Short and readable, J.D. Casanova and A. Landry's *America's French Heritage* (Quebec City: Quebec's Official Publisher, 1976) includes information about the Acadians. Two Louisiana-based scholars, M.P. Rieder and N.G. Rieder, have privately published a number of works on the genealogical records of the Acadians, including *Belle-Ile-en-Mer Registers with the La Rochette Papers*, volume two of a series entitled "The Acadian in France." Their work can be obtained by writing to them at 1457 Poinsetta Drive, Metairie, Louisiana 70005. Also privately published are the genealogical studies made by A. J. Robichaux, *Acadian Marriages in France*, available from him at 532 Manhattan Boulevard, Harvey, Louisiana 70052. *The Acadians, Creation of a People* (Toronto: McGraw-Hill Ryerson, 1973) is a short essay on Acadian history by N.E.S. Griffiths. A history covering the deportation and exile of Acadians is D.J. LeBlanc's *The Acadian Miracle* (Lafayette: Evangeline Publishing Co., 1966).

Mountain Goats (p. 58)

Hoofed Mammals of the World, by illustrator U. Mochi and mammalogist T.D. Carter (New York: Charles Scribner's Sons, 1971), depicts more than 290 ungulates; a chapter on the goat-antelope includes information about the Rocky Mountain goat. The result of a three-year study, G.B. Schaller's *Mountain Monarchs* (Chicago: University of Chicago Press, 1977) is a comprehensive overview of the behavior, ecology, and taxonomy of mountain ungulates in the Himalayas. D. McCowan's *Animals of the Canadian Rockies* (New York: Dodd, Mead and Co., 1936) devotes pages 119–28 to the mountain goat. In "On the Rutting Behavior of Mountain Goats" (*Journal of Mammalogy*, November 1964, pp. 551–68), V. Geist discusses courtship and rut behavior and shows that mountain goats have evolved intense threat displays and reduced their fighting to a minimum. The significance of the goats' coat pattern is also explained. This article includes numerous sketches of goat postures, threat stances, and displays. "Winter Habitat Use by Mountain Goats," a two-volume report by J.W. Schoen (Juneau: Alaska Department of Fish and Game, October 1978; December 1979), assesses the home ranges and seasonal habitat requirements of mountain goats in southeastern Alaska. A twenty-three page description of mountain goat ecology and behavior that includes a bibliography is L.D. Hibb's "A Literature Review on Mountain Goat Ecology" (Colorado Department of Game, Fish, and Parks, and Colorado Cooperative Wildlife Reserve Unit, Special Report, no. 8, July 1966). For a brief, general portrait of the Rocky Mountain goat, see O.P. Breland's "The Mountain Goat" (*Audubon*, May–June 1954, pp. 112–13). V. Geist's *Mountain Sheep* (Chicago: University of Chicago Press, 1971), a study of behavior and evolution, includes some information on goats for comparison. Featuring approximately 200 color photographs, many outstanding, E.R. Ricciuti's *Wildlife of the Mountains* (New

York: Harry N. Abrams, Inc., 1979) is an exploration of some of the animals that inhabit mountains.

East China Sea (p. 70)

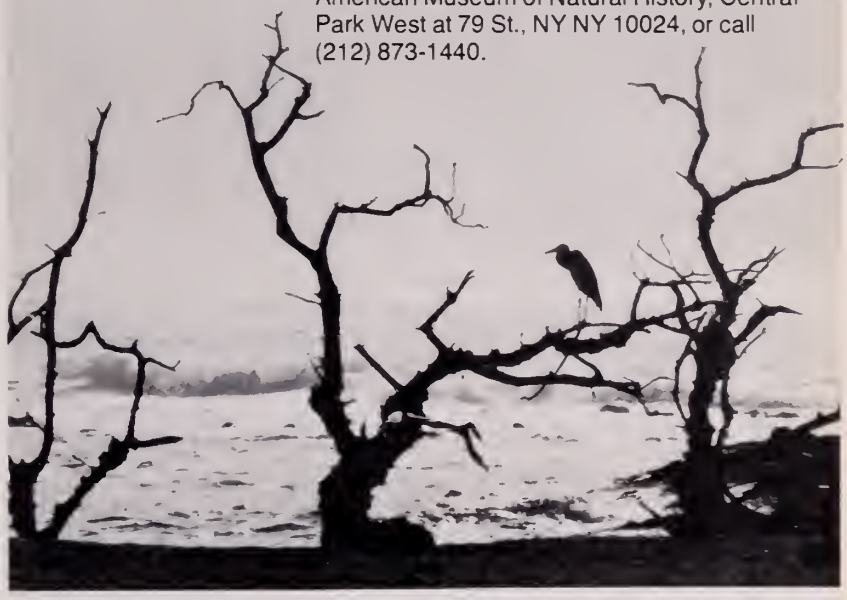
Oceanography in China, a report published by the National Academy of Sciences in April 1980, depicts the state of the Chinese oceanographic community from the end of the Cultural Revolution to the present. The most up-to-date, thorough review of Chinese oceanography, this work is available at a cost of $7.00 from the National Academy of Sciences Press, Washington, D.C. Highly praised, R. Terrill's *Mao* (New York: Harper and Row, 1980), is an account of Chinese society in the 1960s and 1970s. *Chinese American Interactions*, by J.K. Fairbanks (New Brunswick: Rutgers University Press, 1975), is a historical summary of the relations between China and the United States. H.W. Shen's "Some Notes on the Yellow River" (*Eos*, 1979, vol. 60, pp. 543–47) provides some interesting observations about human influence in the area. For abstracts of scientific articles on the East China Sea, consult *Oceanic Abstracts*. In 1979, this journal summarized ten articles about the morphology, hydrology, and taxonomy of the East China Sea. For background material in the field of marine geology, F.P. Shepher's textbook, *Submarine Geology* (New York: Harper and Row, 1974), is a good starting point. Other textbooks with basic information on continental shelves and plate tectonics are B.F. Mallory and D.N. Cargo's *Physical Geology* (New York: McGraw-Hill Book Co., 1979); J.A. Jacobs, R.D. Russell, and J.T. Wilson's *Physics and Geology* (New York: McGraw-Hill Book Co., 1974); and A.N. Strahler's *Principles of Physical Geology* (New York: Harper and Row, 1977).

Rita Campon

American Museum of Natural History
Discovery Tours

GALAPAGOS ISLANDS CRUISE
June 13 to 25, 1981

Share the educational holiday of a lifetime with American Museum scholars and 65 compatible travelers aboard the comfortable M.V. Buccaneer. Enjoy superb climate and sandy beaches, while exploring volcanic landscapes, home to exotic and tame birds and reptiles. For further information write to DISCOVERY TOURS, American Museum of Natural History, Central Park West at 79 St., NY NY 10024, or call (212) 873-1440.



A Natural History Prize Winner



Remember the gentle giants of the sea with this majestic and poignant color lithograph of a sounding humpback whale. This handsome print comes ready-to-hang in a glass-covered silver-tone frame. Available in two sizes. Net proceeds help the Whale Protection Fund.

Qty.	Style and Description	Price
	#8346 11" x 14" photo $15.00 (shipping $2.00 each)	
	#8347 6" x 8" photo $7.50 (shipping $1.50 each)	
	shipping and handling	
	Total Cost	

☐ Check enclosed ☐ Master Charge
☐ American Express ☐ Visa

CARD NO.

EXPIRATION DATE Month___Year___

Daytime phone number ( )

Name:

Address:

City State Zip

☐ Enclosed is my $1.00 for a copy of the Whale Gifts Catalog. Whale Gifts Catalog included free with any purchase.

Whale Gifts 02-A-1
• 2100 M St., N.W. • Wash., D.C. 20037

LEARN PROFESSIONAL PHOTOGRAPHY at home.



Would you like to see your pictures in magazines like this? For 70 years, NYI has trained amateurs to take professional pictures—pictures that get published, win prizes, even lead to a new career. If you love photography, NYI can make it happen for you too.

You'll learn at home in your spare time, with our new "Voice-on-Tape" method that guides you easily through magnificent portfolio-size lessons, illustrated by salon-quality photos of world-famous masters. A remarkable course at surprisingly low cost. Call or send for free informative booklet. No obligation.

Mail coupon OR CALL TOLL FREE 800-453-9000

Yes! Send me the free color booklet about the NYI Course. No obligation. No salesman will call.

Name

Address

City State Zip

☐ Under 18, check here for special information.

New York Institute of Photography
Dept. N11H, 880 Third Ave., N.Y., N.Y. 10022

The Taming of the Grain

North America's native grain, wild rice, has finally been domesticated

by Raymond Sokolov

Unmolested worked the women,
Made their sugar from the maple,
Gathered wild rice in the meadows
Longfellow,
The Song of Hiawatha

Sitting in Cambridge, Massachusetts, in the big Brattle Street house his father-in-law had given him, Longfellow presumed to write an epic of Indian tribal life in northern Minnesota. How true a general picture of Native American civilization by the shores of Gitche Gumee he may have managed to draw I cannot say. But it is certain that the real Minnehahas, when they harvested wild rice for their Hiawathas, did not do the job on any meadow.

Wild rice, the only native North American grain, grows in the lakes and rivers of Minnesota, Upper Michigan, Wisconsin, and adjoining parts of Canada. Wild rice is an aquatic grass, appropriately labeled *Zizania aquatica* in scientific nomenclature. At least the second half of the botanical name is appropriate. *Zizania,* picked as wild rice's genus name for no reason I can fathom, comes from a Greek word for a weed, probably the darnel, that grows among wheat. The vernacular name is even more misleading, since wild rice is not some uncultivated version of domesticated rice, *Oryza*, but closer in nature to wheat. The early French explorers of its native range did not help dispel the general confusion when they dubbed it *folle avoine,* or "crazy oat."

With so much misinformation surrounding wild rice, perhaps Longfellow should be pardoned for his relatively trivial error. It is a shame, though, that he did not know about the exceedingly poetic, traditional Ojibway technique for harvesting wild rice, which would have made a splendid episode in *Hiawatha.*



Instead of striking out over dry land, the Indian women, two to a canoe, collected the rice while entirely waterborne. An observer, writing in 1820, described harvesting on Big Sandy Lake:

> It is now gathered by two of the women passing around in a canoe, one sitting in the stern and pushing it along, while the other, with two small pointed sticks about three feet long, collects it in by running one of the sticks into the rice, and bending it into the canoe, while with the other she threshes out the grain. This she does on both sides of the canoe alternately, and while it is moving.

On a good day the women went home with a canoe full of grain. And that is still the way wild, so-called lake rice is harvested in Minnesota. State law regulates every aspect of the rice harvest, setting an opening day for the season, protecting Indian rights over waters on their reservations, and forbidding the use of any harvesting tools other than Indian-style sticks. Such rules were intended not only to perpetuate a charming technique but, principally, to safeguard the interests of Indians and individuals against competition from an extremely efficient harvesting machine perfected in 1923 and then quickly outlawed after a public outcry went up against it.

As a result, the rice harvest on Minnesota lakes, which normally begins in late August, is what you might call a grass-roots phenomenon involving all manner of folk—Indians and white hobbyists alike. The total crop of lake rice is not immense, averaging about 500,000 pounds a year in the seventies. But the local, atomized nature of the harvest lends it an appealing, communal quality. On the other hand, the scarcity of the grain and its prestige among gourmets have made wild rice an expensive item outside the state, one that is too valuable for many poor Indians to keep for their own use. That, at any rate, is what some Native American radicals charge, yearning perhaps for the return of precolonial days when wild rice played a crucial role in the survival of the 50,000 Ojibways who lived in the forests of the Upper Great Lakes.

Even today it is still possible to ob-



serve Ojibways processing wild rice in the unbelievably laborious traditional manner. First, the green rice has to be cured so that it will not spoil in storage and so that the hull can be removed. Originally, this was done with the heat of the sun or over smoky fires. But when white settlers introduced metal pots, Ojibways quickly switched over to them, toasting the rice in caldrons set over wood fires and stirring the grains with a canoe paddle. At this point, men take over the process. They dig a shallow hole in the ground, line it with skin, and pour in cured rice. Wearing moccasins and leather gaiters to keep rice from working its way inside the moccasins, they literally dance on the rice to loosen the hulls. To gain more leverage and better balance while they "jig," they steady themselves by holding on to poles placed outside the hole. Finally, the winnowed rice is poured over a blanket, so that the wind can blow away the chaff as the heavier grains fall to earth.

Few Indians do this any more. Commercial processors with mechanical parchers, threshers, and winnowers can do the job much faster. But the old ways have not completely died. At Cass Lake, Minnesota, I was able to purchase a small quantity of jigged rice so meticulously produced that it lacked all but the faintest light-brown trace of hull.

The majority of Ojibways prefer to sell their rice as a cash crop to commercial processors. The ultimate product is hard to fault and would probably have been approved by the Ojibways of yesteryear. At Northern Lakes Wild Rice Company in Cass Lake, for example, Ernie and Cindy Anderson do custom processing on a small scale. They live in the midst of Indians, and in the title of the cookbook they have published, *Minnesota Mahnomen Recipes,* they show their respect for Indian ways by perpetuating the Ojibway word for wild rice (*mahnomen* is also the source of the name of a neighboring tribe, the Menominees).

Strictly speaking, one could argue that the Andersons are paying lip service to a tradition they are also exploiting for personal profit. But it is hard to work up much animus against their cottage industry after you have visited the holdings of a new company that has as its aim the cultivation of *Zizania aquatica* on hundreds of acres of paddies.

The very idea of domesticating America's most folkloric wild plant may strike you as an abomination, a final blow struck against the aboriginal order by the same kinds of free-wheeling entrepreneurs who raped the country's forests and pillaged Appalachia's hills. But I was reserving judgment as I flew over the neat paddies in the amphibious plane of one of the company's investors. After all, the original stands of wild rice on the lakes are as safe as a strict environmental code can make them. Meanwhile, below me, an agronomic drama of the first order was in full swing.

It was as if I was on hand for the domestication of corn and wheat from their original wild grasses in prehistoric times. But in twentieth-century Minnesota, a band of green-thumbed businessmen and inventive farmers are accomplishing in a decade the same job that occupied ancient agriculturists for generations.

Modern science and machinery help a great deal. Laser-guided land planes can smooth a paddy on a slight slope so that water drains in and out of an ingenious system of dikes and ditches. Old-time American ingenuity has improvised flotation wheels for a Rotavator that tills the paddies' peat soil without churning it excessively as a plow would. Combines to harvest ordinary rice, built on halftracks and full tracks suitable for soft peat, have been rigged with extra-large headers



Paddy grown wild rice is harvested by combines rigged with extra-large headers to match the plants' height.

that match the height of the wild rice plants.

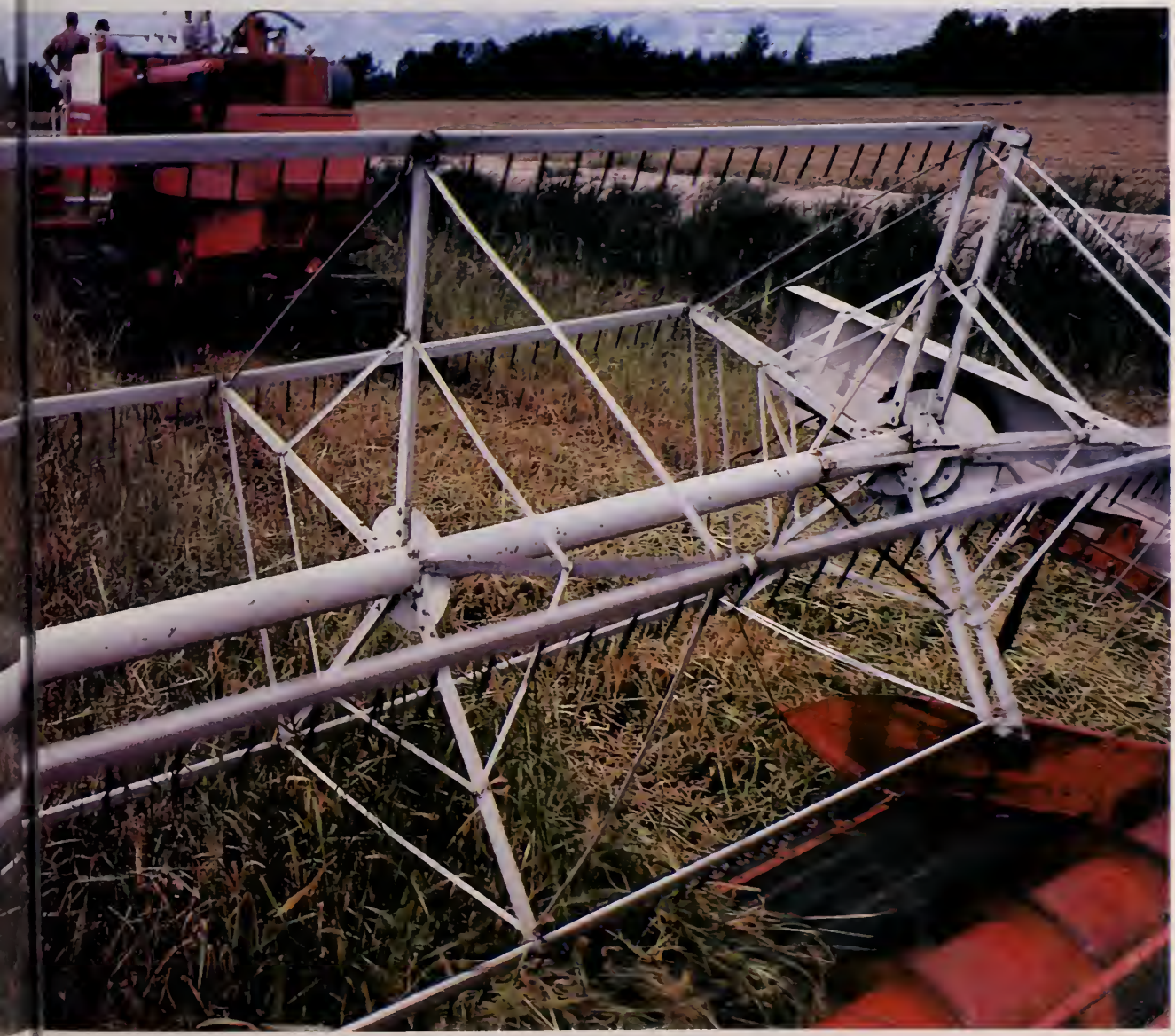
These mechanized marvels were the easy part. They just cost money, lots of money. The hard part was, and to a certain extent still is, finding a strain of *Zizania aquatica* that can be sown and reaped like any other cultivated grain. Over the years many Minnesotans tried to tame wild rice, but they all failed. The plant's basic biology foiled them because the mature seeds—the part we harvest and eat—shatter at maturity and fall off the stem. Worse, seeds of the same plant mature at different times, starting with the topmost and progressing downward along a spikelike cluster. For this reason, traditional lake harvesting has to be done in several stages, with canoes passing through the same stand at intervals of several days, until all the seeds have matured and been knocked off their stems.

The paddy rice farmers can only harvest once, since the combine chews off the plants' entire spikes in one pass. For paddy production, then, the ideal wild rice plant would have seeds that did not shatter; that remained on the plant until the whole spike was ripe.

Pioneers in the paddy business like Harold Kosbau scoured lake crops looking for naturally occurring, nonshattering strains. Eventually, they found them, planted them in paddies, and by 1972, they were in business. Last year paddy production had expanded to 2.2 million pounds, roughly 80 percent of Minnesota's overall crop. And in that same period, after a sophisticated marketing effort by the paddy growers and by wild rice retailers, United States consumption tripled. Meanwhile, the retail price, especially outside Minnesota, zoomed to a level at least as high as $17 a pound. The wild rice market is wilder than the plant. Mail-order sources charge widely divergent amounts, ranging from a low of $5 per pound to $14.50 for ten ounces.

To be sure, there are different grades of wild rice, from fancy long grain to broken debris, but these are unofficial ratings, rarely mentioned and affecting price only erratically. Questions of price apart, in the new, two-tiered wild rice market, there is the further question, the most fundamental of all, Is paddy rice as good as lake rice?

Naturally, the paddy growers' stock response is, "They're genetically the same. There's no difference." This



claim is obviously false. By definition, a nonshattering strain of rice is a genetically different variety from the majority of naturally occurring plants. And the state of Minnesota is full of diehards like Ron Libertus, an Ojibway art historian and special services director for the Minnesota Department of Natural Resources, who will tell you that paddy rice is "a different product," cured longer to soften the harder seed, darker in color, ultimately quite different in taste. Paddy people deny this.

To test the claims of both sides, I collected six samples of lake and paddy rice. All the paddy rice had been industrially processed, except for one package parched and jigged in an exhibition of Indian techniques. The lake rice came from three different sources; one sample had been prepared by hand (foot?). I cooked them all until they began to split so that they would be chewy or what Italians would call *al dente*. Not all the rice turned out this way.

At one extreme, the jigged paddy rice turned to mush in minutes without passing through an intermediate, chewy stage that I could detect. At the other extreme, the very light and delicate, Indian home-processed rice was so light, subtle, and fluffy that it approached true rice in appearance and flavor. Frankly, I preferred the four intermediate varieties, which all had the gutsier, chewier, smokier conventional taste of wild rice, whether they came from lakes or paddies. No doubt, the lake varieties had a gentler feel on the tongue, a higher color, and perhaps a greater complexity of taste. But the distinction seemed to me a very thin one. From lakes or paddies all four samples tasted very good with roast duck.

Ultimately, as paddy cultivation improves its genetic base and expands still further, it may reduce lake harvesting to the status of a colorful hobby. At the moment, however, illogical prices notwithstanding, the market is absorbing lake and paddy production almost indiscriminately. Nevertheless, the advent of paddy rice has already had one clear result. More than a century too late, Longfellow has been vindicated. Minnesotans are finally harvesting wild rice on dry land.

Raymond Sokolov is a free-lance writer whose special interest is the history and preparation of food.



Basic Preparation of Wild Rice

1 cup wild rice
Salt

1. Put rice and 1 teaspoon salt in a saucepan with 3 cups water.
2. Bring to a boil, lower heat, and simmer, covered, for about 30 minutes. It is impossible to give a precise cooking time. Some small-grained, highly polished varieties will cook quickly. Others will take longer, up to 50 minutes. But wild rice is not nearly so sensitive as ordinary rice. By all means uncover the pan and taste as often as you like. If cooked too long, wild rice turns to mush and loses much of its taste and nutritional value. But if you catch it just as the grains begin to split, it will have an appealingly crunchy texture and a nutty flavor.
3. Drain and serve. Leftover rice will keep for several days under refrigeration. Or it can be frozen. It will also stand up to reheating very nicely, especially if it has not been overcooked the first time around.

Yield: About 4 cups or 6 servings

Wild Rice Muffins

(Adapted from *Wild Rice For All Seasons Cookbook*, by Beth Anderson. $6.95 postpaid from Minnehaha Publishing, Suite 406, 625 Second Avenue, Minneapolis, Minnesota 55402)

1 cup cooked wild rice
2 eggs, lightly beaten
5 tablespoons oil
1 cup milk
1¼ cups flour
1 tablespoon baking powder
½ teaspoon salt
3 tablespoons sugar

1. Preheat oven to 425 degrees. Grease a 12-muffin tin.
2. Stir the wild rice together with the eggs, oil, and milk in a mixing bowl.
3. Combine the flour, baking powder, salt, and sugar in another bowl. Stir together until well mixed.
4. Stir the dry ingredients into the liquid ingredients, gradually and thoroughly, until blended.
5. Spoon the batter into the muffin cups. Bake 15 to 18 minutes, until lightly browned.

Yield: 1 dozen muffins



Real quality has a way of creating its own image.

Images can be fleeting. A shadow. A rippling picture in a pond. Or they can be as lasting as a lifetime. A lifetime of hard work.

As a maker of home appliances, Whirlpool Corporation believes that a lasting quality image is simply the reflection of the people who build and stand behind the product. Special people. Motivated by pride of concept. Of craftsmanship. Of their ability to make things that last.

This is why we take pride in stocking parts for as many years as we do. Why we maintain a toll-free Cool-Line® service number* you can call 24 hours a day. And why we have a nationwide organization of authorized Tech-Care® service companies that are as close to you as your phone book.

You see, at Whirlpool we believe every appliance we build should create its own image of quality. And do it for one person—you.

It's our way of saying this is more than just an appliance. This is our way of life.

Whirlpool
Home Appliances

*800-253-1301 In Alaska and Hawaii 800-253-1121. In Michigan 800-632-2243

THE TASTE BEYOND 12-YEAR-OLD SCOTCH



Discover more.

Let your mature taste lead you from the finest premium Scotch on up to the most expensive 12-year-old Scotch in the world. The Glenlivet. The ultimate in Scotch.

Most premium Scotch is blended and depends on several whiskies for taste and smoothness.

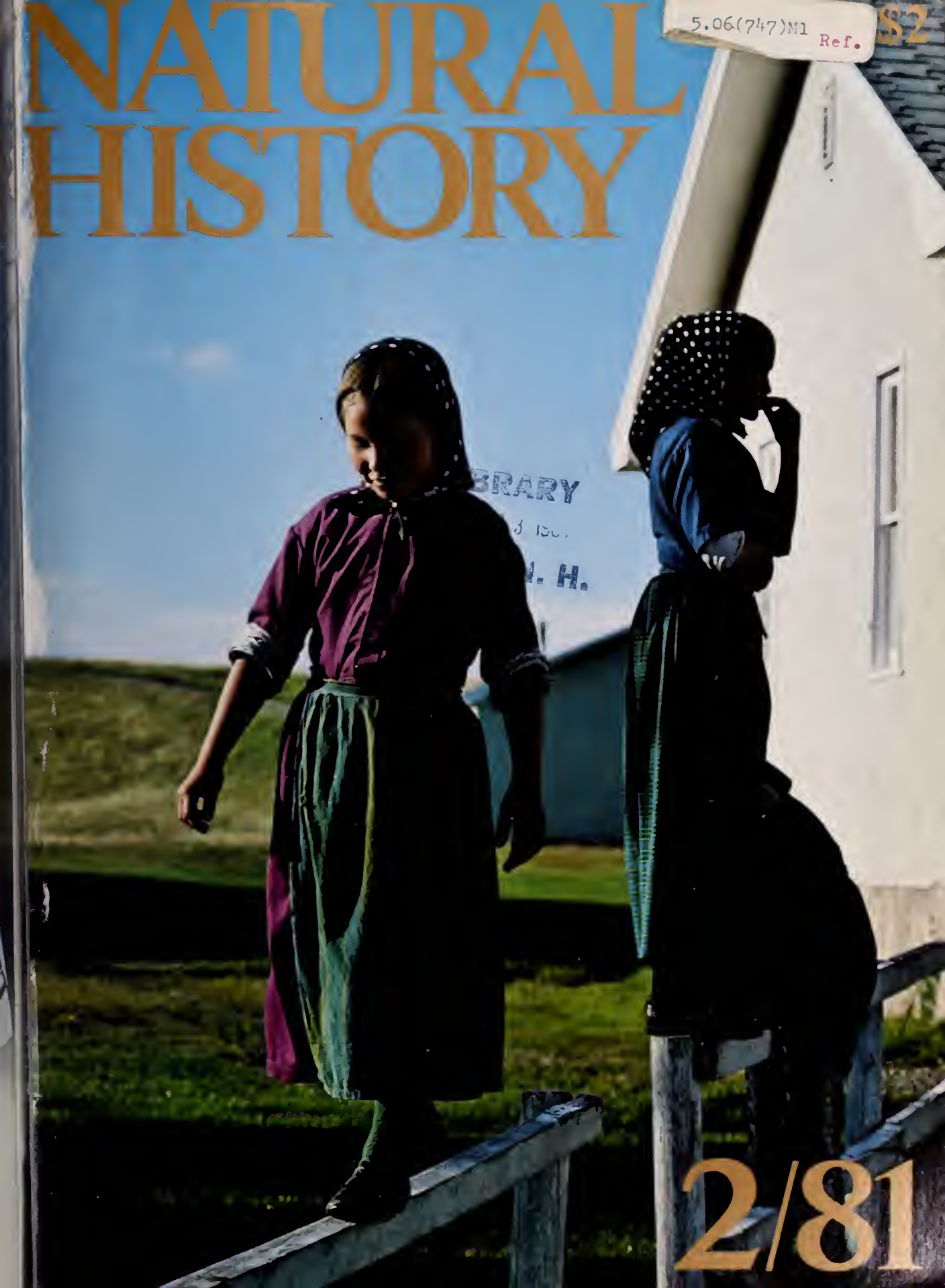
Yet the unblended character of The Glenlivet is noble enough to stand alone. In this distinctive Scotch whisky you'll experience an exceptional smoothness and full-bodied richness, unmatched in all other premium Scotch.

Try the taste beyond premium Scotch.

The Glenlivet
Unchanged since 1824.

NATURAL HISTORY

5.06(747)M1 Ref.



BRARY
. H.

2/81

STARTING TODA
LESS T

Introducing the totally new Lynx from Lincoln-Mercury. Lynx has the highest gas mileage label of any front-wheel-drive car made in America. But Lynx gives you more than just exceptional fuel efficiency.

30 *EPA EST. MPG 44 HWY. EST.

Lynx gives you a special inner world. With more space than Honda Accord, VW Rabbit or Toyota Corolla SR-5. (Based on EPA Interior Volume Index.) With more than 55 standard features: deep-padded seats that have their own coil suspension, a "soft-feel" padded instrument panel with "soft-glow" lights, over 53 square feet of plush carpeting, padded contoured armrests, to name but a few.

Lynx gives you a world of things for your peace of mind. A vast array of Ford Motor Company Lifeguard Design Safety Features that



LYNX FROM LI

*Hatchback: 30 EPA EST. MPG, 44 HWY. EST. Applicable to units without power steering or A/C. †Wagon: 26 EPA EST. MPG, on speed, trip length and weather. Actual hwy. mileage lower. Comparisons exclude diesels, other Ford products and Cal.

THE WORLD IS THIRSTY

include a high-strength reinforced roof structure, and energy-absorbing side-door panels. Plus, Lynx gives you a world of firsts. Lynx is the first American-built compact with a fully independent suspension on all 4 wheels. For a smooth ride and precise handling. The first with a "swirl-effect" Compound Valve Hemispherical Head engine. For optimum fuel efficiency. And the first that also gives you a wagon which is more fuel-efficient than any other made in America.‡ Starting today, the world belongs to an American car. Starting today, the world belongs to Lynx.

LYNX
LINCOLN-MERCURY DIVISION



LINCOLN-MERCURY

‡ 36 HWY. EST. Optional automatic transmission. Use these numbers for comparison. Your mileage may vary depending where ratings are lower. Buy or Lease at your Lincoln-Mercury dealer.

NATURAL HISTORY

Vol. 90, No. 2, February 1981
American Museum of Natural History
Robert G. Goelet, President
Thomas D. Nicholson, Director

Alan Ternes, Editor
Judith Friedman, Managing Editor
Thomas Page, Designer
Board of Editors:
Sally Lindsay, Frederick Hartmann, Vittorio Maestro, Rebecca B. Finnell
Carol Breslin, Book Reviews Editor
Florence G. Edelstein, Copy Chief
Rita Campon, Copy Editor
Angela Soccodato, Art Asst.
Kay Zakariasen, Picture Editor
Douglas J. Preston, Publications Editor
Susan Rosenberg, Editorial Asst.
Lillian Berger
Editorial Advisers:
Malcolm Arth, James W. Atz, Mark Chartrand, Niles Eldredge, Lee Herman, E. Craig Morris, Norman Newell, Thomas D. Nicholson, Martin Prinz, Gerard Piel, Nina Root, François Vuilleumier

David D. Ryus, Publisher
Bradford D. Smith, Business Manager
Frederick E. Grossman, Production Mgr.
Ernestine Weindorf, Administrative Asst.
Laurie G. Warhol, Advtg. Production Mgr.

Barbara Lynn Gutman, Circulation Mgr.
Daniel J. Dynan, Asst. Circulation Mgr.
Bob Bruno, Fulfillment Mgr.

NATURAL HISTORY *(ISSN 0028-0712), incorporating Nature Magazine, is published monthly by the American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024.*
Subscriptions: $15.00 a year. In Canada and all other countries: $18.00 a year. Second-class postage paid at New York, N.Y. and at additional offices.

Copyright © 1981 by American Museum of Natural History. All rights reserved. No part of this periodical may be reproduced without written consent of Natural History. *The opinions expressed by authors do not necessarily reflect the policy of the American Museum.*

Natural History *is indexed in* Reader's Guide to Periodical Literature.

Advertising Offices:
Natural History Sales
488 Madison Avenue
New York, N.Y. 10022
President of Sales, Arthur Hill Diedrick
Advertising Manager, Katherine José

Telephone Numbers:
Advertising Sales (212) 826-9467
Museum Information (212) 873-4225
Subscription Orders (800) 526-0331 outside N.J.
(800) 932-0834 in N.J.

Change of address notices, undeliverable copies, orders for subscriptions, and other mail items are to be sent to
Natural History Membership Services
Box 4300
Bergenfield, New Jersey 07621

4 Authors

6 Culinary Themes and Variations *Elisabeth Rozin and Paul Rozin*
The boredom of a simple, predominantly vegetable diet has inspired a wide range of spicy seasonings.

16 This View of Life *Stephen Jay Gould*
Hyena Myths and Realities

28 A Naturalist at Large *Peter H. Raven*
Tropical Rain Forests: A Global Responsibility

34 Children of the Hutterites *Gertrude Enders Huntington*
After rigorous training and schooling, few youngsters care to leave these hard-working, religious communities.

48 The Eskimo vs. the Walrus vs. the Government *Dan Strickland*
Old customs, a lucrative ivory trade, and new weapons all contribute to a conservation dilemma.

58 Acid Rain and Gray Snow *George R. Hendrey*
Ironically, acidification makes lake water clearer.

66 Italian Wolves *Erik Zimen*
Little known, these wild animals survive near human settlements by stealth and cunning.

82 Sky Reporter *Eugene R. Capriotti*
Seyfert Galaxies

91 Celestial Events *Thomas D. Nicholson*

94 Books in Review *Victor B. Scheffer*
High Living

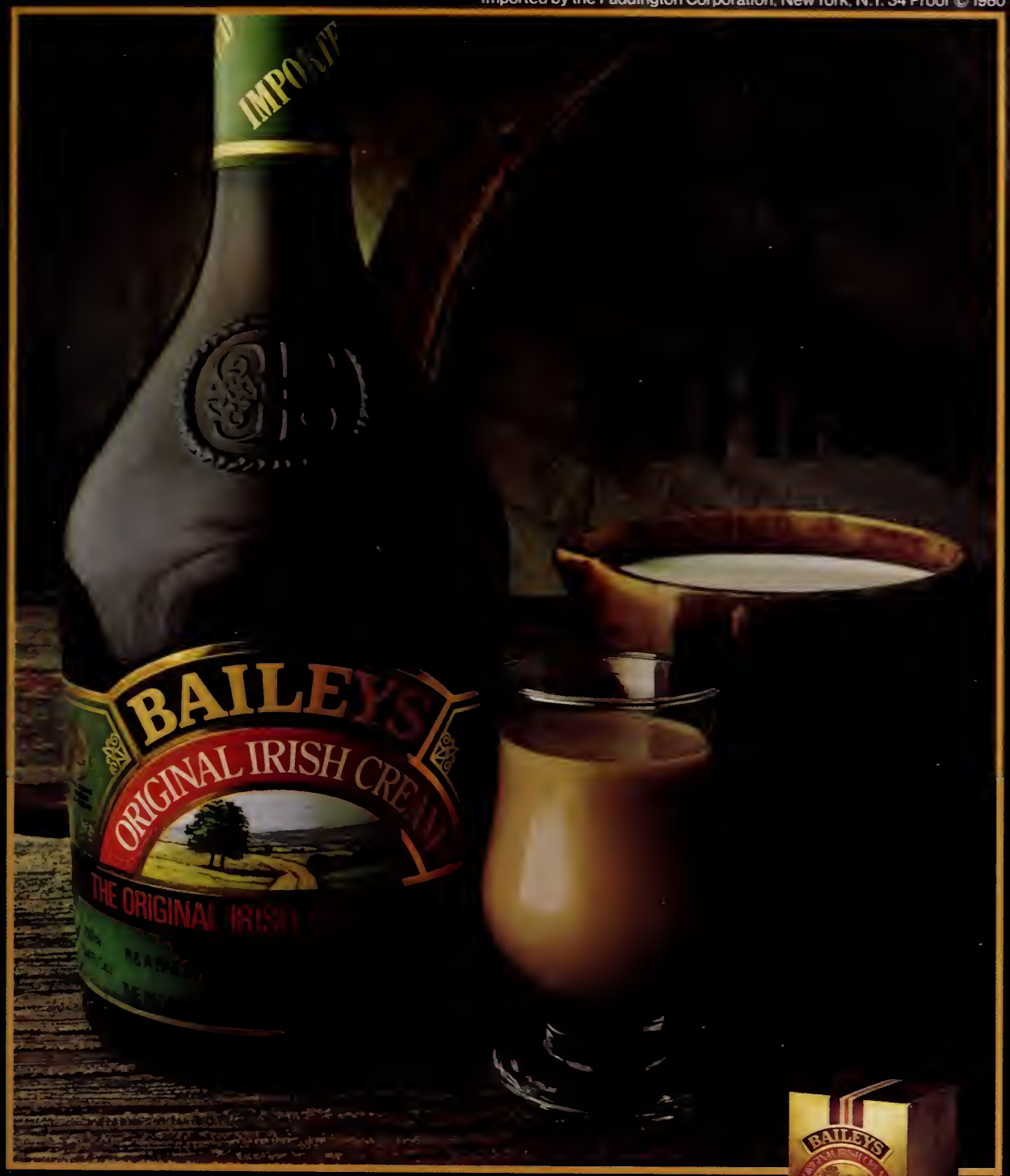
98 At the American Museum
The Edge of Sight

100 Additional Reading

102 A Matter of Taste *Raymond Sokolov*
Forbidding Fruit

Cover: *Long skirts and polka-dotted head scarfs are the traditional dress of Hutterite girls. Photograph by Robert Weinreb. Story on page 34.*

Imported by the Paddington Corporation, New York, N.Y. 34 Proof © 1980



BAILEYS.
THE ORIGINAL IRISH CREAM LIQUEUR.

THE CREAM IS REAL. THE WHISKEY IS REAL.
ONLY THE TASTE IS MAGIC!

My inclination toward anthropology probably began in my childhood," says **Gertrude Enders Huntington.** "When I was ten years old I visited the Cuna Indians off the coast of Panama. I was the first white female child most of the women had ever seen." Huntington attended Oberlin College, graduated from Swarthmore College, and received her Ph.D. from Yale University. She has taught biology, done fieldwork in Turkey, and written a five-volume dissertation entitled *Dove at the Window: A Study of an Old Order Amish Community in Ohio.* As principal fieldworker on the Hutterite Socialization Study, she and her family lived as Hutterites in a Canadian colony for an extended period of time.





As a game biologist for the Alaska Department of Fish and Game, **Dan Strickland** monitored the walrus harvest off the islands of Saint Lawrence and Little Diomede. These experiences drew him into the thick of the controversy involving walrus hunting and Eskimo subsistence. Currently working as a commercial fisherman in the Alaskan gill net salmon industry, Strickland is also doing research on the Prince William Sound fishery. When not fishing or watching walrus, he backpacks and skis cross-country in the Alaskan bush.

George A. Hendrey is deeply concerned with the fate of fish and other life forms in freshwater lakes and streams, although he admits he doesn't have the patience to be a fisherman himself. Trained in aquatic biology, he has done limnological research in the United States and Norway. Born and raised in Seattle, Hendrey likes to spend time in the mountains and has arranged his professional life "so as to make that possible." His favorite sport used to be downhill skiing, but during a three-year stay in Norway, he became a convert to the cross-country variety. Hendrey earned his B.A. and Ph.D. degrees at the University of Washington. Since 1977 he has served as an ecologist in the Department of Energy and Environment at Brookhaven National Laboratory in Upton, Long Island.



When he was fifteen, German-born **Erik Zimen** joined his family for a one-year visit to the United States. During their stay, the Berliners viewed the exhibitions at the American Museum of Natural History. Zimen, a research assistant at the University of Saarbrücken, West Germany, writes that his interest in ethology began at that time. After receiving his Ph.D. in zoology, physiology, and anthropology from the University of Kiel, he conducted fieldwork on wolf ecology and conservation in the Abruzzi Mountains of Italy. He has also done work on the ecology of the red fox in southwestern Germany and is planning an evaluation of the status of the wolf in Poland, Czechoslovakia, Romania, and Yugoslavia.



THE COMPUTER ALSO HEATS THE BUILDING.

The energy crunch.

It's been on our minds at IBM for quite some time.

Back in 1973 we began offering computer systems that manage energy as only a computer system can.

These systems take thousands of energy-saving actions every day, based on information about weather conditions, use patterns, and other factors.

They turn lights on and off. Turn heat and air conditioning units on and off. Control hot water heaters as needed. And more. All to prevent waste.

In one of our customer's buildings, a system we installed cut the power bill by over $8000 in the first month.



And in the headquarters building of the IBM division that builds these systems, energy management equipment recycles heat generated by the computer installation itself. The outside temperature has to drop below 11° F before the boilers need to be turned on.

Energy management systems obviously conserve energy.

But what they really do is manage things better and more economically than people can manage them alone.

That's what computer systems are very, very good at doing. IBM

Culinary Themes and Variations

Traditional seasoning practices provide both a sense of familiarity and a source of variety

by Elisabeth Rozin and Paul Rozin

Every morning in a small village in the southern highlands of Mexico one can hear in every home the rhythmic sounds of the grinding stone. Between these stones, or *metates,* are, without fail, chili peppers, and frequently tomatoes, being ground into the *salsa* ("sauce") for the day. The *salsa* will appear at almost every meal; when it is absent, the chili peppers, often combined with tomato or lime, turn up as components of cooked solid foods and soups. A ubiquitous feature of Mexican cuisine, the chili pepper, along with the staples corn and beans, is an essential part of what makes Mexican food "Mexican."

This Mexican village is not unique, for the same processes take place in every other Mexican village although the ingredients may vary slightly from one village to another. So it is in other parts of the world as well. One can observe in the Brahman Tamil cuisine of southern India, for example, the same kind of daily seasoning preparation: the soaking of tamarind, the grinding of chili pepper, the frying of mustard seed, turmeric, and hing powder (asafetida). These and other flavorings, used daily on almost all cooked staple foods, create the identity of this cuisine.

Such flavoring practices are very widespread but seem to occur most frequently in tropical or semitropical areas or, what may be the same thing, in cultures that depend more heavily on plant foods than animal foods. Thus the most distinctive and easily described seasoning traditions occur in China, Southeast Asia, Africa, India, the Mediterranean, and South and Central America. Seasoning practices may range from the use of one specific, pervasive flavoring ingredient (the use of coconut in the islands of Oceania) to much more complex and elaborate bonds or combinations of flavoring ingredients (the spice mixtures of North African or Indian cuisine). Within cultures that characteristically season their foods, the use of combinations of flavoring ingredients is the most common technique: the soy sauce and rice wine and ginger root bond of China; the soy sauce and sesame seed and chili bond of Korea; the "curry" spice mixtures of India; the tomato and garlic and olive oil bond of southern Italy. These distinctive and pervasive flavoring combinations, which we call "flavor principles," seem to impart a clear and characteristic identity to the foods of any group. Cultures that reliably season their cooked foods do not, for the most part, utilize these seasonings in sweets and beverages.

The use of characteristic seasonings, whether singly or in combination, is not universal in human culinary practice; in cuisines that have a high proportion of animal foods (meat or dairy products) in their diet and in many cuisines of temperate and polar regions there is typically no strong dependence on flavoring ingredients. This tendency results in culinary products that are relatively less "marked" than the products of cuisines that season heavily. Characteristic seasonings provide a gustatory "theme" that identifies and unites the products of a cuisine so that, for example, having sampled at random several Mexican or Indian dishes, one would have a good chance of identifying new instances of dishes from these cuisines. This would probably not be the case in the relatively less marked cuisines of England or Germany.

Most of the world's people seem to belong to well-marked cuisine groups that create culinary products with distinctive and describable gustatory themes. The traditional seasonings are "loved" by the members of these groups. They find it difficult to imagine food prepared without them. Faced with a hypothetical absence of chili, for instance, members of a Mexican village kept inventing ways of getting some—from neighbors, stores, or markets—rather than face the possibility of eating a meal without it. Chili is craved: food simply doesn't taste good without it.

This attachment to traditional flavorings seems to be as strong, if not stronger, than the attachment to traditional staple foods. Human beings are remarkably conservative in their food habits and are typically reluctant to try new foods and to abandon old familiar ones. Although some new foods have been introduced and accepted in both Mexico and China, for example, the ancient flavoring traditions, many of them thousands of years old, persist unchanged to this day. Traditional flavorings are high-priority culinary items and immigrant groups typically go to great lengths and expense to procure them in foreign settings. After many generations in the mixed culture of Israel, the basic flavorings of the original home country (either Eastern European or Mediterranean or indigenous Israeli) still predominate in the individual's daily diet.

The desire to re-create familiar tastes is illustrated nowhere more poignantly than in the behavior of Vietnamese refugees in an American resettlement camp that we visited in the fall of 1975. Vietnamese food is characteristically seasoned with *nuoc*



1981 FORD BRONCO: MILES AHEAD IN MPG AND ADVANCED DESIGN.

Bronco, the 4-wheel utility economy champ. It's the family 4-wheeler totally redesigned last year for the needs of the 80's. The only one that can give you advanced features like tough, independent front suspension and optional 4-speed overdrive transmission to boost fuel economy, particularly at highway speeds. Any way you figure, you're ahead in a tough Bronco!

Built Ford Tough

BEST SIX UTILITY MPG

18 EPA EST. MPG* 24 EST. HWY.*

Standard 4.9L (300 CID) Six with 4-speed overdrive transmission option.



20% Better gas mileage for the '81 Bronco over last year's 6-cylinder estimated MPG.

NEW Snow Plow Prep Package
Fully equipped for snow plow service, from HD axle to alternator. Bronco plays hard, works hard!

*Compare these estimates with others. Your mileage may differ depending on speed, distance and weather. Actual highway mileage will probably be less. California estimates lower.

NEW OPTION 4-speed overdrive
For Ford Bronco. Helps improve fuel economy.

NEW OPTION Automatic locking hubs
Front hubs run free on highway; lock automatically when you shift to 4WD.

TOUGH Twin-Traction Beam
Independent front suspension to step over bumps for a stable ride.



FORD

FORD DIVISION Ford

mam, a salty, fermented fish sauce, typically mixed with vinegar and chili. The camp kitchens, staffed by U.S. Army cooks, attempted to accommodate Vietnamese taste by providing some traditional staple foods: chicken, fish, rice, vegetables. But the well-loved *nuoc mam* was not available. When the kitchen staff discovered, by trial and error, that the most popular flavorings were soy sauce and hot pepper sauce, a bottle of each was always placed on every table in the mess hall. The cooks told us, with some incredulity, that the refugees would pour soy sauce and hot pepper sauce on all their foods, mix them together, and then eat them. They went through supplies of these sauces at a most remarkable rate. The refugees were doing the best they could, in a strange environment and with limited ingredients, to duplicate the traditional flavors of their cuisine. (*Nuoc mam* is now widely available in Oriental groceries throughout the United States; the demands of the Vietnamese have produced a steady supply.)

The flavoring of food—that is, the deliberate manipulation of food by adding ingredients that will reliably alter the taste—is a uniquely human behavior. There are no animals that characteristically mix their foods with anything that could be called a flavoring, even including the possibility of marking the food with a bodily secretion. The one possible exception is the troupe of monkeys on Koshima Island in Japan that has developed a tradition, "invented" by an adult female, of dipping sweet potatoes in saltwater before eating them. This one example may be the only reported seasoning behavior from the animal kingdom.

Why do human beings, or at least most human beings, flavor their foods? What is the function of seasoning traditions, handed down from one generation to the next? One can understand how the attachment to the flavors of their native cuisine might develop in individuals as a result of continued exposure from early childhood (and possibly even earlier still from mother's milk). But what is the adaptive value of this generally widespread and ancient practice?

Surely, any particular flavoring ingredients used—chili, cumin, garlic, or whatever—are largely determined by their availability in the environment. But availability alone cannot explain the exclusive, persistent, and prevalent use of certain flavorings in any culture. Frequently, some available flavorings are rejected, while others not easily obtained are widely sought after. The age of exploration in Europe, for example, was largely motivated by a specific lust for seasoning ingredients, particularly pepper.

It is possible that some flavoring ingredients have specific biological value, in terms of either nutritive or physiological effects. Because such seasoning elements are typically eaten in small amounts, they cannot supply a significant amount of macronutrients, like protein and fat, but they might well provide valuable vitamins or minerals. Chili pepper, for example, is a very rich source of vitamins A and C. These vitamins are in short supply in the diets of some cultures that use chili; in these cases chili can provide a significant percentage of vitamin A and C requirements, for example, in some areas of Mexico.

A few flavoring ingredients may have medicinal benefits: one of the better documented examples is the antibacterial effect of garlic. Certain physiological effects of the ingestion of some flavoring ingredients may also have adaptive value: chili pepper causes facial sweating, thereby facilitating heat loss in hot environments. Like some other irritant spices, chili stimulates salivation, gastric secretion, and gut motility, and thus may facilitate the chewing and digestion of high-starch diets. Research and ingenuity could probably provide a possible specific effect for each of the many flavoring ingredients used throughout the world. Although such adaptive explanations might well be valid, they are unsatisfactory because they provide a set of individual and specific explanations for a class of related and general phenomena. And such specific explanations cannot account for the pervasive use of seasonings on almost all staple foods.

There are several other possible general explanations. Traditional flavors may serve the same function as traditional costume or traditional religious practice. They are a means of defining a culture group, of identifying an individual with it, and of separating that group from others. Whatever broad human needs are served by such visible in-group behavior, distinctive culinary practices must surely be a part of it.

Another explanation focuses on the salient sensory properties of flavoring ingredients. These elements, particularly when combined in the bonds of flavor principles, almost always have a strong and distinctive flavor. From a broad cultural-ecological perspective, it is those cultures that rely on a bland starch staple with small amounts of meat that have the most marked cuisines in terms of flavor. Indeed, the common explanation offered by individuals from a marked cuisine that the flavors add "zest" or "taste" to their food has some force.

Flavoring ingredients may also be distinctively colored—for example, chili, turmeric, saffron, soy sauce—and may thus impart a characteristic rich and warm color to the food. Again, with bland or light-colored staples (rice, refined wheat), color can provide visual zest, and through both taste and appearance give a meaty quality to the diet. Given that meat is a highly preferred food in almost all cultures, flavoring traditions might well be a response to an absence or shortage of meat in the diet.

A final explanation, which we shall develop more fully, ascribes the widespread use of flavor principles to a basic feature of human biology: our omnivorous heritage.

Human beings are omnivores, or food "generalists," that is, they consume a wide variety of food substances. Unlike food "specialists," who rely almost completely on one or a few varieties of food, omnivores can select their diet from a theoretically almost limitless range of items, a range defined by availability in the environment and by competition with other species. (For convenience, we will use the term omnivore but our comments hold for all generalists, including general herbivores.) The omnivore has much greater flexibility in exploiting the potential nutrient sources of the environment and in exploring and invading new habitats. Furthermore, by consuming a wide variety of foods, the omnivore can minimize the effects of mildly toxic or nutritionally imbalanced substances by utilizing them as only partial nutritional support.

A major cost of omnivorousness is that it makes great demands on behavioral capacities. The food specialist consumes such a small variety of foods that recognition of appropriate food items (specific types of leaves, flying insects, and so on) can be genetically built in. Specifically tuned receptors could never be constructed for the

Take 20 Color Slides of Picasso's Masterpieces for only $1

(comparable value $20)

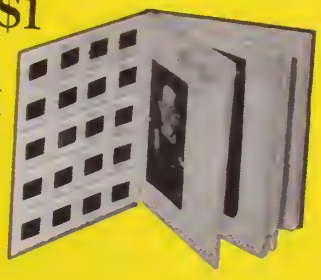
Please enter my trial subscription to this completely new Color Slide Program and send me the Picasso Album (including 20 color slides and 47-page illustrated lecture). Bill me only $1, plus a few cents tax and shipping. If I am not delighted with this introductory package, I may return everything within 15 days, cancel my subscription, and owe nothing.

If I do continue, you will send me a new Color Slide Album approximately every six weeks (for 15 days trial examination) and bill me at the subscriber's low price $12.95, plus tax and shipping. I may take as few or as many Albums as I like, and may stop whenever I wish. After my fourth shipment I will be given a choice of receiving all remaining Albums in one convenient shipment, or continuing with single album shipments.

☐ Check here if you wish the Kodak Carousel BC 604 Projector, and remit the low subscriber's price of only $99.50 plus tax, with this card in envelope addressed to McGraw-Hill Color Slide Program of the Great Masters. If not delighted, return projector within 15 days for full refund.

This offer applies to U.S. only.

Included—at no extra cost—this Illustrated 47-page Gallery Lecture Guide



Name_____

Address_____

City_____

State_____ Zip No._____

McGraw-Hill Color Slide Program
of the Great Masters.
Dept. AY-149, 1221 Avenue of the Americas
New York, N. Y. 10020

Natural History

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO. 26 NEW YORK, N.Y.

POSTAGE WILL BE PAID BY ADDRESSEE

McGraw-Hill
Color Slide Program
of the Great Masters
1221 Avenue of the Americas
New York, N.Y. 10020

20 Color Slides of PICASSO Masterpieces for only $1 (comparable value $20)



THREE MUSICIANS (1921)—a monumental work of Picasso's late Cubist style.



ACROBAT'S FAMILY WITH AN APE (1905)—a "Rose Period" masterpiece, is notable for its span of contrasting forms.



WOMAN'S PROFILE ON RED BACKGROUND (1959) a beautiful example of Picasso's late style.

THE BLIND MAN'S MEAL (1903)—This haunting work from Picasso's "Blue Period" reflects his obsessive fear of blindness.



Turn your living room into your own private Art Gallery



Includes this Illustrated 47-page Gallery Lecture Guide

HERE'S WHAT YOU GET FOR ONLY $1

PABLO PICASSO, a handsome Album with 20 beautiful color slides, including the playful and amusing "Three Musicians," the memorable portrait, "Gertrude Stein" . . . "The Women of Algiers" . . . "Mandolin and Guitar" . . . and other dazzling Picasso masterpieces. The Album also contains an illustrated 47-page guided lecture by modern-art expert John Galloway, who gives you revealing background on the paintings and the prolific genius who created them.



The Color Slide Program of the Great Masters

You're invited to a feast.

Come enjoy a glorious banquet of form, color, visual rhythm, and inexhaustible imagination . . . created by the towering genius of 20th century art—Picasso!

No other artist ever produced so many masterpieces that appear so unlike each other — or mastered so many styles, only to move beyond them. As William S. Rubin of New York's Museum of Modern Art has observed: "More than just a great artist, Picasso was a phenomenon. There is virtually nothing in modern art that he has not invented, influenced, or practiced."

PABLO PICASSO—the complete Art Album with 20 full-color slides and handsomely illustrated Gallery Lecture Guide—is yours for only $1.00 as your introduction to the McGraw-Hill Color Slide Program of the Great Masters. There is no obligation to buy anything more.

View the priceless works of art in the full glory of the originals

Each lavish Album contains twenty color slides devoted to the works of a famous master. Created by art photography specialists in Florence, Italy, these exquisite 35mm slides achieve what small print and art reproductions cannot — for they capture the authentic colors of the original works . . . with every subtle line and detail brilliantly revealed. And they permit you to view each priceless painting on your home screen in the full glory of the original.

In addition, bound into each Album is an illustrated, 47-page Guide in which a noted authority points out important aspects of each painting and shares with you fascinating glimpses of the artist himself.

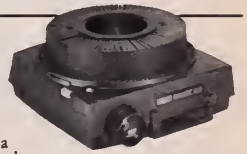
As you view the paintings projected on your wall and read the absorbing commentary, you and your family will discover a whole new dimension in the enjoyment of art. Indeed, it is much like taking your own "private tour" with an art expert at your side.

The Program is flexible — the cost is low. Approximately every six weeks, you are offered a complete new Color Slide Album of 20 distinctive slides and an illustrated lecture. Forthcoming Albums will be devoted to the lives and works of such great masters as Michelangelo, Winslow Homer, Rembrandt, Gauguin, and Da Vinci, Chagall, Van Gogh, Lautrec, etc.

If the slides were available from museums, you would expect to pay as much as $20 a set. Yet, as a member of this new Program, you pay only $12.95 for each complete Album—including 20 color slides and 47-page illustrated lecture. And you may take just as many as you like.

Accept this $1 demonstration offer

To introduce you to the McGraw-Hill Color Slide Program of the Great Masters, we will send you PICASSO, complete for 15 days trial. If you are delighted with the demonstration, send only $1, plus a few cents for tax and shipping. If not thrilled with the introductory Album, simply return it within 15 days; and you will be under no further obligation. Mail the attached card today.



If you do not have a projector: here's an unusual opportunity. We can offer you the sensational Kodak Carousel BC 604 Projector supplied with a 300 watt lamp, and 4-inch f/2.8 Ektanar lens. This top-rated projector shows all the regular 2" x 2" 35mm slides up to 1/16-inch thick. It has dependable gravity feed and you have instant access to any one of its 140-slide capacity at any time. List price $139.50—subscribers' low price only $99.50 plus tax (you SAVE $40). Send remittance with trial subscription form. If not completely delighted with the projector, return it in 15 days for full refund.

If Reply Card has been removed, write McGraw-Hill Color Slide Program of the Great Masters. Dept. AY-149, 1221 Ave. of the Americas, N.Y., N.Y. 10020.

L.L.Bean®

Outdoor Sporting Specialties



FREE Spring Catalog

Fully illustrated. Features quality apparel and footwear for men, women and children; fishing, hiking, camping and canoeing gear. For 69 years L. L. Bean has offered practical and functional merchandise at reasonable prices. Many items of our own manufacture. All fully guaranteed.

☐ **SEND FREE CATALOG**

Name _____

Address _____

City _____

State_____ Zip_____

L. L. Bean, Inc.
701 Casco St., Freeport, ME 04033

Collector's Find!



SOLID BRASS UNICORN

The stuff that dreams and songs and legends are made of . . . a magical unicorn, captured in gleaming, solid brass. Magnificently detailed . . . so real, you can almost hear him breathe. This mythical creature, discovered in a long-ago, far-away garden, symbolizes purity and innocence—and good fortune to anyone who catches one. An enchanting objet d'art for display shelf, executive desk, mantel, boudoir . . . Splendid gift for collectors of things bright and beautiful. A majestic 8" tall with protective felt base. *Brass Unicorn* (Z644559) Only $19.99 + $2.00 P&H. 2 for $38.00 + $3.50 P&H. FULLY GUARANTEED. PA Residents add Sales Tax.

PENNSYLVANIA STATION, Dept. PZ-8618
340 Poplar St., Hanover, PA 17331

huge number of nutritive or dangerous substances that the omnivore encounters. The omnivore must have another type of system for identifying and evaluating these many substances; this is especially important because of the high incidence of toxic substances in the natural world.

Without an innate food recognition system, how does the generalist manage? Although some mammalian omnivores, including humans, do have minimal preprogrammed guidelines (approach to sweet tastes and avoidance of bitter tastes), individual experience predominates in the evaluation of foods. And of course humans have the mediation of culture, which includes accumulated knowledge about valuable and dangerous substances and methods for treating certain items that, once detoxified, are nutritionally beneficial.

Of all behavior, eating is surely the most intimate because it involves the irrevocable incorporation of things into the body; once past the lips and down the gullet the substance becomes at least cognitively a part of the organism. Such an interaction must be both intensely satisfying and extremely threatening. Strong, positive, affective responses accompany eating, while, when new foods are involved, the possibility of bodily harm promotes fear and hesitation. This approach–avoidance conflict is one aspect of the omnivore's dilemma. Trying new foods is at the core of omnivorousness, but so is being wary of them. A delayed, cautious, and gingerly sampling of new foods is common in a number of omnivorous species.

Within the familiarity of one's culture the fear side of eating is attenuated. But when one leaves the safety of the home environment and travels to far and exotic places, the conflict appears: there is an interest in new foods and a simultaneous fear of eating them, a conflict frequently resolved by restricting eating to the safe haven of the Cairo Hilton or a MacDonald's in Bangkok. (Indeed, the uniformity and total predictability of the fast-food chains may be a response to this side of the omnivore's dilemma.) A person may both seek and withdraw from exotic foods, and the balance may shift in different individuals and in different circumstances. Although the preference for a new food increases the more times it is experienced without negative consequences, this may be, at least partially, a result of the dissipation of fear of new things. However, extensive exposure may also lead to boredom and rejection. This encourages the omnivore to continue exploring new food sources and discourages heavy reliance on one food. And so we have a second aspect of the omnivore's dilemma, which can now be seen as twofold: (1) curiosity about new foods versus fear of new foods and (2) the satisfaction with familiar food versus the boredom that overexposure can produce.

It is our belief that the widespread human tendency to season foods with recurrent, predictable combinations of flavoring ingredients can be seen as a cultural response to the omnivore's dilemma. The ambivalence of eating, the pleasure–fear balance, depends on the familiarity of the food. Reliably clothing the food in a distinctive and familiar flavor can tip the balance to the side of pleasure: it provides a taste that has always been safe and enjoyable, that is associated with satiety and the appropriate social context. The flavor furnishes a familiar frame for the food of a culture, passed along from generation to generation.

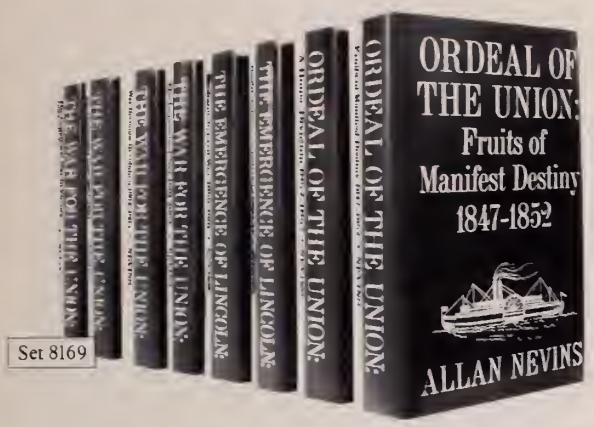
If the approach–avoidance conflict can be significantly reduced by the use of familiar, traditional flavors, it might well be an adaptive means of disseminating a nutritious, new food staple within a culture. By labeling a food with the appropriate flavor, it is "certified," as it were, as familiar and safe to eat. Having discovered the safety and nutritional value of a new food through personal experience or through information received from outside, the pioneer "sampler" within a culture could announce its acceptability by treating it as a traditional food, preparing it with familiar flavor principles and cooking techniques. Indeed, Parmentier, the eighteenth-century French agriculturist, did just this in order to persuade the French people to accept the potato, a valuable food staple brought from the New World. The French would have nothing to do with this new food until Parmentier showed them how to prepare it in traditional ways and with familiar seasonings: butter, cheese, herbs. The strategy worked, and the potato has risen in the French culinary repertoire from initial rejection to enormous popularity.

We don't know very much about how, on the individual level, new foods

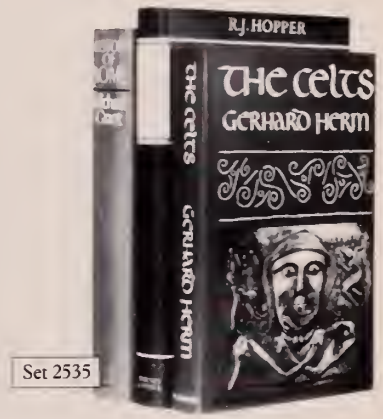
Drink deeply from the wellspring of history...

Choose Any Set For A Dollar A Volume

A rare opportunity to enrich your library with one of these enduring works, at a fraction of its usual cost. Savings up to $192, with trial membership.



Allan Nevins'
THE ORDEAL OF THE UNION
8 Volumes, Publisher's Price $200.00/*Yours For Only $8*
The masterwork of this great historian. Monumental account of our national history, 1847 to 1865. Told with a sweep and passion that is almost Tolstoian.
"We are not likely to see more history of this character and scope for some time to come."
–N.Y. Times, National Book Award



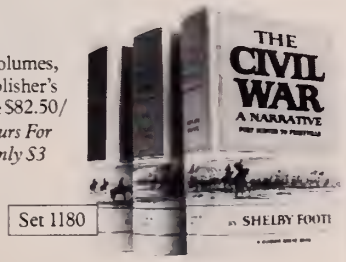
GREAT ANCIENT CIVILIZATIONS
3 Volumes, Publisher's Price $55.00/*Yours For Only $3*
Exciting studies of history's most remarkable cultures. Michael Grant's *History of Rome*, R. J. Hopper's *The Early Greeks*, and Gerhard Herm's *The Celts*.

3 Volumes Publisher's Price $75.00/ *Yours For Only $3*



Douglas Southall Freeman's
LEE'S LIEUTENANTS: A STUDY IN COMMAND
The remarkable commanders of Lee's Army of Northern Virginia and how they waged–and almost won–the Civil War. 2,395 pages; 24 portrait photographs; 107 military maps.

3 Volumes, Publisher's Price $82.50/ *Yours For Only $3*



Shelby Foote's
THE CIVIL WAR: A Narrative
By a historian who is also a gifted novelist–the opening shot at Fort Sumter through the surrender at Appomattox. "A remarkable achievement, prodigiously researched, vigorous, detailed, absorbing."–N.Y. Times

2 Volumes Publisher's Price $50.00/ *Yours For Only $2*



THE GROWTH OF THE AMERICAN REPUBLIC
A 50th anniversary edition of an American classic, updated to include the important issues of the late '70's. Two-volume boxed set.

The story of history, and the men who made it, makes for reading that is both lively and valuable. Now in its 34th year, the Club provides its members with the finest new books of history and world affairs–always at substantial savings.

For a mere dollar a volume, we'll send you any one of the magnificent sets pictured–with your first selection at the low member's price (any book listed at right).

Membership Benefits

A membership account will be opened for you, to which your purchases will be charged at the low member's prices. You need pay only after you have received your books. A postage-and-packing fee is added to each shipment.

Every four weeks (13 times a year) you will receive our *Review* containing descriptions of new and recent selections. If you want the Editor's Choice, do nothing; it will be sent to you automatically. If you want another book, or no book at all, return the card by the date specified. If you should receive an unwanted book because you had less than ten days to decide, you may return it and pay nothing. We guarantee postage.

PICK ONE OF THESE SELECTIONS AT THE LOW MEMBER'S PRICE:

(First price is publisher's list. **Boldface** shows member's price.)

2170. **Lost Country Life.** *By Dorothy Hartley.* $14.95/**$9.90**

2832. **The End of Order: Versailles 1919.** *By Charles L. Mee, Jr.* A lucid, forthright approach to the history of the Versailles conference. $15.95/**$10.95**

5207. **Plagues and Peoples.** *By William H. McNeill.* Impact of diseases on civilizations from prehistory to the present. $10.00/**$7.75**

8250. **Babylon.** *By Joan Oates.* $16.95/**$10.95**

8284. **The Devil's Horsemen: The Mongol Invasion of Europe.** *By James Chambers.* $11.95/**$8.95**

8797. **The Orphan Brigade: The Kentucky Confederates Who Couldn't Go Home.** *By William C. Davis.* $12.95/**$9.50**

8847. **Stonehenge and Its Mysteries.** *By Michael Balfour.* A fascinating and scientifically sound look at Stonehenge through the ages. $14.95/**$9.90**

8938. **The Gnostic Gospels.** *By Elaine Pagels.* $10.00/**$8.50**

2725. **The Days of the French Revolution.** *By Christopher Hibbert.* $12.95/**$9.95**

2790. **Luther: An Experiment in Biography.** *By H. G. Haile.* $14.95/**$10.50**

W1H1A

THE HISTORY BOOK CLUB · Stamford, Conn. 06904

Please enroll me as a trial member and send me the books whose numbers I have entered below. Bill my set at $1 a volume and my other selection at the low member's price, plus postage-and-packing.

Set = ____ Selection = ____

I may return the books within three weeks at your expense and owe nothing. Or, I will buy four more selections within a year *(not counting my choices above).* Membership is cancellable anytime thereafter. All Club purchases are at low member's prices, and a postage-and-packing fee is added to all shipments. NH-53W

Print Name _____

Address _____ Apt. = ____

City _____

State _____ Zip _____

In Canada mail to: The History Book Club, 16 Overlea Blvd., Toronto M4H 1A6, Ontario.

are introduced into a culture. We do have some data, however, indicating the importance of flavor principles in treating new food items. In a Mexican village where we observed food habits closely, a number of women were asked how they would prepare three items they had never eaten before. The three "foods" were sardines (one of the few canned foods available in the village store but rejected by a majority of the residents), alfalfa (an animal food), and a common shrub not considered food. All responses included flavoring the item with chili, the indispensable flavor-principle component. Several of the other responses indicated the use of lime, another traditional flavoring ingredient. In all these cases, the women had no reason to believe these new foods would cause them any harm, although they had no desire to try them. When faced with hypothetical use, however, they treated them like familiar foods. There is something to be said then for the reassuring nature of traditional seasonings; they are the familiar culinary theme, linking together the known and the traditional with the new and the unfamiliar.

But what of the omnivore's second problem, the need for variety and the reduction of boredom? With the rise of agriculture and the growing dependence on a few staple crops, the number of different foods eaten by most cultures dropped; it is probably still the hunter-gatherer who, even in marginal environments, consumes the greatest variety of food items. Elaborate culinary preparation (in terms of techniques, equipment, and novel combinations of ingredients) can produce variety, and this greater complexity of culinary procedure occurs in virtually all cultures that rely primarily on the staple-plant diet. But how can the placing of a recurrent flavor combination on almost all foods at almost all meals, reassuring as it may be, also provide variety and reduce boredom?

The answer may come from a close study of the use of flavor principles in cuisine. What seems a monotonous repetition of flavorings may well be an illusion of the outsider, just as all red burgundies taste alike to the inexperienced wine drinker. A closer look at actual culinary practice reveals a rich and subtle variation of flavoring from dish to dish and from meal to meal. In the Mexican village we studied, for example, chili pepper is used in many ways. It is cooked into soups and stews or sliced and placed upon other foods or ground into a sauce, often with tomatoes and other ingredients. At least ten types of chili peppers are used in this village: some are fresh, some are dried, some are red, others green, some strongly piquant, others less so. They differ somewhat in the type of "burn" they produce in the mouth. And villagers assure us that each type of chili has a different taste. Some kinds of peppers are used interchangeably with others in the making of soups or sauce. A few may be mixed together one day, a different combination on the next, but their use is far from random: some varieties are specified for certain culinary preparations. The chili ancho, for example, a large and relatively mild variety, is used almost exclusively in *moles*, the traditional stewed meat dish of the region. The number of different kinds of chili peppers available in the area is quite large. Nine homes that we surveyed had from three to six different chilis in the house, while in the large regional market of Oaxaca, dozens of varieties can be found. Within the single "theme" of this Mexican chili pepper flavor principle there is a great deal of subtle and controlled variation.

The same kind of theme and variation can be shown to function in other cuisines that consistently utilize recurrent combinations of flavoring ingredients. Indian cookery is characterized by a flavor that naïve outsiders call "curry"; curry, in fact, does not refer to the flavor of the food but to dishes that have a sauce. Within the realm of curried, or sauced, preparations, there is no single flavor but, again, a recurrent combination of ingredients that are manipulated with great subtlety and surprising variety. Brahman Tamil cuisine of southern India relies heavily on several core seasoning ingredients, including chili pepper, asafetida, mustard seed, tamarind, fresh coriander, and turmeric. A close inspection of Tamil recipes, however, reveals that this general theme is varied from dish to dish: sometimes all the ingredients appear, sometimes only one or two; the relative proportions differ from preparation to preparation; and the basic flavor is varied with the frequent addition of other seasoning ingredients such as coconut, coriander seed, and cumin. Again, what may look and, indeed, taste, like the very same thing to the outsider is not the same thing at all to the insider. Simple and complex variations are created by the individual cook within the thematic limits set by the traditions of the cuisine.

We suggest, then, that the prevalent human practice of adding characteristic combinations of flavors to most foods may be the result of our omnivorous heritage and an expression of our unique humanity: we have other things to do with food than merely to consume it. To appease our fear of the new and to support our satisfaction with the familiar, we create a label or theme. But at the same time, to avoid monotony and to satisfy our desire for variety, we play with the theme, fashioning as we do so, the elaborate and richly textured composition we call cuisine.

Elisabeth Rozin, author of The Flavor Principle Cookbook, *teaches and writes about cuisine and is a chef in Philadelphia. Paul Rozin, professor of psychology at the University of Pennsylvania, is a psychobiologist. His wife's interest in flavor principles drew him into the study of human food habits and how people develop likes and dislikes for foods.*

WHEN YOU WRITE TO NATURAL HISTORY

about a change of address, renewal of subscription, billing, or any kind of adjustment, send the present address label from the magazine wrapper.

Moving? Please notify 6 weeks in advance. You can use this form to tell us about a move or order a subscription.

Change of address—Attach your address label in the dotted area and fill in your new address below, clip and mail to Natural History Membership Services, P.O. Box 4300, Bergenfield, N.J. 07621

Cut your old address label from magazine wrapper and attach over this area.
Fill in your NEW address and mail to:
Natural History Magazine
Membership Services P.O. Box 4300
Bergenfield, N.J. 07621

PLEASE PRINT

Name _____

New Address _____

City _____ State _____ Zip _____

Some people feel...

"So what if I'm young. I've never had an accident or even gotten a ticket. Why should I pay the highest insurance rates?"



That's why we want you to know...

We understand how you feel. You've got a good driving record, and that's great. And you don't expect to have an accident. No one does. But the fact is that good drivers as well as bad have accidents. That's why insurance protection exists.

No one can predict which individual is going to have an accident. But we can predict the accident potential for groups of drivers who share similar characteristics. This is the only way possible to make auto insurance rates.

Insurance companies set their rates to reflect how often they have to pay claims of insured groups and how much those claims cost. This is done for each state and for each rating territory within the state.

Year after year, without exception, statistics show a consistent pattern: younger drivers have more accidents than older drivers. Young males have more accidents than young females. And young unmarried males have more accidents than young married men.

The fairest way to distribute accident costs is for each driver to pay an insurance rate that reflects as closely as possible the exposure to loss of his or her group. Of course, differences within the groups also are taken into account. Among them are the age and type of car and how the car is used (whether for business, pleasure or commuting).

But take heart. If you have a good driving record, you will pay less than others in your group who have been involved in serious accidents or who have been guilty of major traffic law violations. And, as you get older, the accident potential of your group will decline, and so will your rates.

We're working to keep insurance affordable.

This message presented by the **American Insurance Association,** 85 John Street, NY, NY 10038

Hyena Myths and Realities

Both male and female genitals are strikingly similar. Why?

by Stephen Jay Gould

I freely admit that the spotted, or laughing, hyena is not the loveliest animal to behold. Still, it scarcely deserved the poor reputation imposed upon it by our illustrious forebears. Three myths about hyenas helped to inspire the loathing commentary of ancient texts.

Hyenas, first of all, were regarded as scavengers and consumers of carrion. In his *Natural History,* Pliny the Elder (A.D. 23–79) spoke of them as the only animals that dig up graves in search of corpses (*ab uno animali sepulchra erui inquisitione corporum*). Conrad Gesner, the great sixteenth-century cataloger of natural history, reported that they gorge themselves so gluttonously after finding a corpse that their bellies swell to become taut as a drum. They then seek a narrow place between two trees or stones, force themselves through it, and extrude the remains of their meal simultaneously at both ends.

Hans Kruuk, who spent years studying spotted hyenas on their home turf (the plains of East Africa), has labored to dispel these ancient myths (see his book *The Spotted Hyena*, University of Chicago Press, 1972). He reports that hyenas will scavenge when they get the opportunity. (Almost all carnivores, including the noble lion, will happily feast upon the dead product of another animal's labor.) But spotted hyenas live in hunting clans of up to eighty animals. Each clan controls a territory and kills most of its own food —mainly zebra and wildebeest—in communal, nocturnal pursuit.

As a second insult, hyenas were widely regarded as hybrids. Sir Walter Raleigh excluded them from Noah's ark in 1614 since he believed that God had only saved the purely bred. Hyenas were reconstituted after the flood through the unnatural union of a dog and cat. In fact, the three living species of hyena form a family of their own within the order Carnivora. They are most closely related to the viverrids (weasels and their allies).

As a final, phony blot on their escutcheon, and in the unkindest cut of all, many ancient writers charged that hyenas were hermaphrodites, bearing both male and female organs. The medieval bestiaries, always trying to draw a moral lesson from the depravity of beasts, focused on this supposed sexual ambivalence. A twelfth-century document, translated by T. H. White, declared:

> Since they are neither male nor female, they are neither faithful nor pagan, but are obviously the people concerning whom Solomon said: "A man of double mind is inconstant in all his ways." About whom also the Lord said: "Thou canst not serve God and Mammon."

But hyenas also had some formidable defenders against this particular calumny. Aristotle himself had declared in the *Historia animalium:* "The statement is made that the hyena has both male and female sexual organs; but this is untrue."

Aristotle—and not for the first time —was right of course. But the legend had arisen for a good reason. Female hyenas are virtually indistinguishable from males. Their clitoris is enlarged and extended to form an organ of the same size, shape, and position as the male penis. It can also be erected. Their labia have folded up and fused to form a false scrotum that is not discernibly different in external form or location from the true scrotum of males. It even contains fatty tissue forming two swellings easily mistaken for testicles. Authors of the most recent paper on spotted hyenas found the appearance of males and females "so close that sex could only be determined with certainty by palpation of the scrotum. Testes could be located in the scrotum of the male compared with soft adipose tissue in the false scrotum of the female."

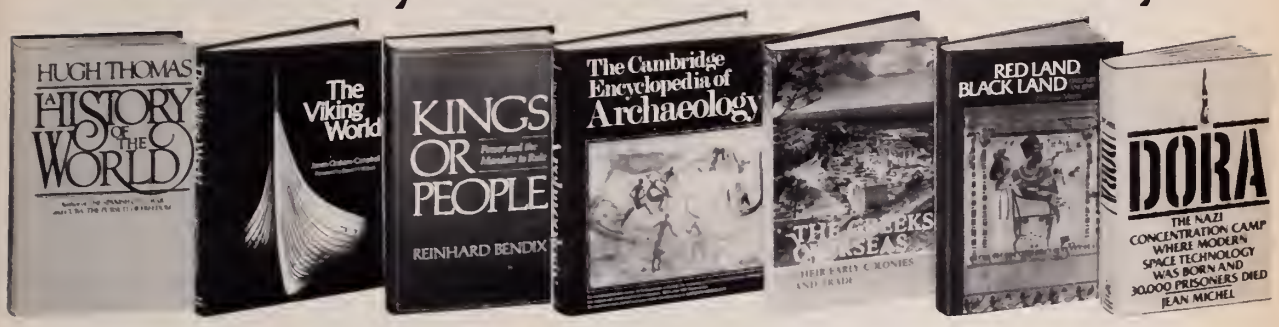
British zoologist L. Harrison Matthews wrote the most extensive anatomical description of the hyena's sexual anatomy in 1939 (*Philosophical Transactions of the Royal Society of London,* vol. 230). He described the peniform clitoris, emphasizing that it is no smaller than the male penis, is equally constricted to a single slitlike opening at the tip, and is as subject to erection as its male counterpart. He concluded his dry and precise pages of description with as forceful a statement of wonder as measured British scientific prose would allow: "It is probably one of the most unusual of the forms which the external orifice of the urogenital canal takes amongst female mammals."

Matthews also investigated the interesting question of how hyenas do it, given a female orifice no larger than the slit of a male's penis. "In the pre-pubertal state," he writes, "these functions are obviously impossible, owing to the minute size of the opening." But as the female matures the slit gradually lengthens and "creeps down round the ventral surface . . . travelling down the midline" until it forms an orifice 1.5 cm long and extending from the tip of the clitoris to its base. This lengthening of the slit and a subsequent enlargement of the nipples following pregnancy and parturition help distinguish older females from males. We can now understand the basis for ancient myths that hyenas were either simultaneous hermaphrodites (bearing male and female organs at the same time) or male for part of their life and then female.

Nature's oddities cry out for explanation, and we must ask what advantages females gain from looking like males. Immediately, we come upon the other most striking oddity of hyena biology: females not only resemble males; they are also larger than males, contrary to the usual pattern in mammals, including humans. Females in Kruuk's East African clans averaged 120 pounds in body weight versus 107 pounds for males. Moreover, they lead the clans in hunting and defense of territory and are generally dominant over males in individual contacts. Dominance is not merely a result of larger size because

From the growth of Greek civilization...
to the origin of the Cold War—all in the

Library of World History



Take any 3 books for only $1.00 each
(values to $67.50)

if you will join now for a trial period and agree to take only 3 more books—at handsome discounts—over the next 12 months

(Publishers' Prices shown)

53088. A HISTORY OF THE WORLD. *Hugh Thomas.* A fascinating overview of human development. **$17.95**

85853-2. THE VIKING WORLD. *James Graham-Campbell.* Contains over 300 illustrations. *Counts as 2 of your 3 books.* **$25.00**

57150. KINGS OR PEOPLE: Power and the Mandate to Rule. *Reinhard Bendix.* An examination of early political traditions and the development of modern society. **$22.50**

34315. THE ARCHAEOLOGY OF MESOPOTAMIA. *Seton Lloyd.* Over 170 photos, drawings, and diagrams. **$17.95**

37209-2. THE CAMBRIDGE ENCYCLOPEDIA OF ARCHAEOLOGY. *Edited by Andrew Sherratt.* Oversized volume. Contains over 400 illustrations and covers 50,000 years. *Counts as 2 of your 3 books.* **$34.95**

82771-2. TEMPLES, TOMBS AND HIEROGLYPHS/RED LAND, BLACK LAND. 2 introductions to ancient Egypt. *Counts as 2 of your 3 books.* **$25.90**

45220-2. ENGLISH SOCIAL HISTORY. *George Macaulay Trevelyan.* Survey of English manners and morals from Chaucer to the end of the Victorian era. *Counts as 2 of your 3 books.* **$29.50**

34720. THE ATLAS OF AFRICAN HISTORY. *Colin McEvedy.* With 58 full-page maps and an authoritative text by Facts-on-File. **$17.50**

48665. FLORENCE IN THE FORGOTTEN CENTURIES. *Eric Cochrane.* The lives of six talented men tell the story of Florence from the heroic siege of 1530 to the Risorgimento. **$16.50**

41775. THE DEATH OF WOMAN WANG. *Jonathan D. Spence.* A vivid recreation of rural life in 17th-Century China. **$10.95**

51150. THE GREEKS OVERSEAS: Their Early Colonies and Trade. *John Boardman.* **$22.50**

56208. AN INTRODUCTION TO ANCIENT EGYPT. *T.G.H. James.* Contains 100 black-and-white photos and 20 full-color plates. **$20.00**

42345-2. DISCOVERY OF LOST WORLDS. *Edited by Joseph J. Thorndike, Jr.* The major archaeological finds of the past 300 years. *Counts as 2 of your 3 books.* **$34.95**

37391-2. THE CELTIC WORLD. *Barry Cunliffe.* Superb archaeological-historical survey. *Counts as 2 of your 3 books.* **$39.95**

87680. A WORLD HISTORY. *William H. McNeill.* Classic narrative of the four major Old World civilizations—the Middle East, India, China, and Europe. **$19.95**

37262. CAESAR'S INVASION OF BRITAIN. *Peter Berresford Ellis.* **$17.50**

85838. VICTORIAN WORKING WOMEN: Portraits from Life. *Michael Hiley.* Social history of the working-class poor. **$17.50**

78304. SIDESHOW: Kissinger, Nixon and the Destruction of Cambodia. *William Shawcross.* **$13.95**

62915-2. MONUMENTS OF CIVILIZATION: Ancient Cambodia. *Mazzeo and Antonini.* Contains over 100 color photographs. Oversized volume. *Counts as 2 of your 3 books.* **$25.00**

54995. THE ILLUSTRATED ENCYCLOPEDIA OF ARCHAEOLOGY. *Glyn Daniel.* **$17.95**

55007. THE IMAGE OF THE NEW WORLD. *Brotherston and Dorn.* The New World as seen through the eyes of its original inhabitants. Filled with myths and folklore. **$19.95**

59537. THE MAKING OF ADOLF HITLER. *Eugene Davidson.* **$17.50**

42529. DORA: The Nazi Concentration Camp Where Modern Space Technology Was Born and 30,000 Prisoners Died. *Jean Michel.* **$12.95**

46260. EUROPE BETWEEN THE SUPERPOWERS: The Enduring Balance. *A.W. DePorte.* **$18.50**

60555-2. MARITIME ARCHAEOLOGY. *Keith Muckelroy.* The ancient secrets of the ocean depths revealed by today's archaeologists. *Counts as 2 of your 3 books.* **$37.50**

62895. MONTAILLOU. *Le Roy Ladurie.* Portrait of medieval life: the passions, hopes and dreams of everyday people. **$20.00**

37326. CARNIVAL IN ROMANS. *Le Roy Ladurie.* A riveting study of culture conflict that led to disaster. **$20.00**

66280-2. THE ORIGINS OF THE COLD WAR IN THE NEAR EAST: Great Power Conflict and Diplomacy in Iran, Turkey and Greece. *Bruce R. Kuniholm. Counts as 2 of your 3 books.* **$27.50**

42219. THE FACTS ON FILE DICTIONARY OF EUROPEAN HISTORY: 1485-1789. *E.N. Williams.* **$22.50**

61645. THE MEANING OF HITLER. *Sebastian Haffner.* Answers the lingering questions surrounding Hitler's conduct. **$7.95**

4 Good Reasons to Join

1. The Finest Books. Of the hundreds and hundreds of books submitted to us each year, only the very finest are selected and offered. Moreover, our books are always of equal quality to publishers' editions, *never* economy editions.

2. Big Savings. In addition to getting 3 books for $1.00 each and the *Hammond Atlas of World History* FREE when you join, you keep saving substantially—up to 30% and occasionally even more. (For example, your total savings as a trial member—including this introductory offer—can easily be over 50%. That's like getting every other book free!)

3. Bonus Books. Also, you will immediately become eligible to participate in our Bonus Book Plan, with savings of at least 70% off the publishers' prices on any book offered in the Club.

4. Convenient Service. At 3-4 week intervals (16 times per year) you will receive the Book Club News, describing the Main Selection and Alternate Selections, together with a dated reply card. If you want the Main Selection, do nothing and it will be sent to you automatically. If you prefer another selection, or no book at all, simply indicate your choice on the card, and return it by the date specified. You will have at least 10 days to decide. If, because of late mail delivery of the News, you should receive a book you do not want, we guarantee return postage.

Library of World History J-AJ8
Riverside, New Jersey 08075

Please accept my application for trial membership and send me the three volumes indicated, billing me only $1.00 each. I agree to purchase at least three additional Selections or Alternates over the next 12 months. Savings range up to 30% and occasionally even more. My membership is cancelable any time after I buy these three books. A shipping and handling charge is added to all shipments.

3 books for $1 each.
Indicate by number the books you want.

Plus my free gift—Hammond Atlas of World History (52115)
A few expensive books (noted in book descriptions) count as more than one choice.

No-Risk Guarantee: If you are not satisfied—for any reason—you may return your introductory books within 10 days and your membership will be canceled and you will owe nothing.

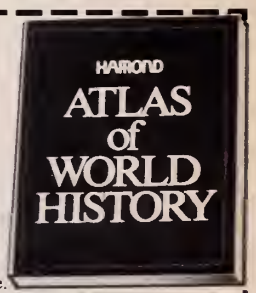
Name_____

Address_____

City_____

State_____ Zip_____

(Offer good in Continental U.S. and Canada only. Prices slightly higher in Canada.)



FREE—for joining now

9½" × 13½" hardcover atlas featuring over 100 maps illustrating the most significant periods and events in history.

females also rank higher than larger males if the discrepancy in size is not too great.

Although the female hyena's assumption of what are usually male roles in mammals is probably related to its evolution of sexual structures that mimic male organs, the link between these phenomena is not immediately clear. It cannot have much to do with sexual performance itself for, if anything, the female "penis" is a hindrance to copulation until its opening enlarges and its form departs from that of the male.

Kruuk suggests that the strong mimicry arose in connection with a common behavior in hyenas called the "meeting ceremony." Hyenas live in clans that defend territories and engage in communal hunting. But individuals also spend much of their time as solitary wanderers searching the landscape for carrion. To maintain the cohesion of the clan and to keep strangers away, hyenas must develop a mechanism for recognizing each other and reintegrating solitary wanderers into their proper clan.

When two hyenas of the same clan meet, they stand side to side, facing in opposite directions. They each lift their inside hind leg, subordinate individual first, exposing either an erect penis or clitoris, one of the most vulnerable parts of the body, to their partner's teeth. They then sniff and lick each other's genitals for ten to fifteen seconds, primarily at the base of the penis or clitoris and in front of the scrotum or false scrotum.

Kruuk believes that the female clitoris and false scrotum evolved to provide a conspicuous structure serving for recognition in the meeting ceremony. He writes:

> It is impossible to think of any other purpose for this special female feature than for use in the meeting ceremony. . . . It may also be, then, that an individual with a familiar but relatively complex and conspicuous structure sniffed at during the meeting has an advantage over others; the structure would often facilitate this reestablishment of social bonds by keeping partners together over a longer meeting period. This could be the selective advantage that has caused the evolution of the females' and cubs' genital structure.

Speculation about adaptive significance is a favorite, and surely entertaining, ploy among evolutionary biologists. But the question, "What is it for?" often diverts attention from the more mundane but often more enlightening issue, "How is it built?" In this case, speculations about adaptive significance have been in the literature for a long time, yet no one bothered to tread the obvious path for hypotheses of anatomical construction until 1979: What sexual hormones are maintained at what levels by female hyenas from conception to maturity? (See P. A. Racey and J. D. Skinner, "Endocrine Aspects of Sexual Mimicry in Spotted Hyenas, *Crocuta crocuta,*" vol. 187, *Journal of Zoology,* 1979, pages 315–26.)

Racey and Skinner found, in short, that two androgens (male-producing hormones) had higher concentrations in testicles than in ovaries of adult spotted hyenas (scarcely surprising). Yet, when they investigated levels of the same hormones in blood plasma, they detected *no differences* between males and females. One female contained two twin female fetuses, and both, despite their tiny size relative to their mother, contained about the same level of testosterone as adult females. Racey and Skinner therefore conclude "that high foetal androgen levels are responsible for the appearance of the male sexual facies in adult female spotted hyenas."

Confirmation for their hypothesis arises from their study of brown and striped hyenas, the other two species of the family Hyaenidae. Neither brown nor striped hyenas develop peniform clitorises or false scrotums. In both species, androgen levels in blood plasma are much lower for females than for males. (Aristotle, by the way, defended hyenas against the charge of hermaphroditism by correctly describing the genitalia of these other species—something of a dodge with respect to the spotted hyena, the source of the legend, but "the master of them that know" was right in any case.)

But why should high levels of androgenic hormones lead to the building of false penises and scrotums. The animals that construct them are still, after all, genetically female. How can female genes produce mimics of male structures, even under the influence of unusually high levels of androgenic hormones. A look at the developmental basis of sexual anatomy resolves this dilemma.

Mammals share a common pattern for the embryology of sexual organs, and we may therefore use humans as an example. The early embryo is sexually indifferent and contains all precursors and structures necessary for the development of either male or female organs. After about the eighth week following conception, the gonads begin to differentiate as either ovaries or testes. The developing testes secrete androgens, which induce the development of male genitalia. If androgens are absent, or present at low levels, female genitalia are formed.

The internal and external genitalia develop in different ways. For internal genitalia, the early embryo contains precursors of both sexes: the Müllerian ducts (which form the Fallopian tubes and ovaries of females) and the Wolffian ducts (which form the vas deferens—the ducts that carry sperm from the testes to the penis—in males). In females, the Wolffian ducts degenerate and the Müllerian ducts differentiate; males develop by the opposite route.

The external genitalia follow a markedly different pattern. Individuals do not begin with two distinct sets of precursors and then lose one while strengthening the other. Rather, the different organs of male and female develop along diverging routes from the *same* precursor. The male's penis is the same organ as the female's clitoris—they form from the same tissues, are indistinguishable in the early embryo, and follow different pathways later. The male's scrotum is the same organ as the female's labia majora. The two lips simply grow longer, fold over and fuse along the midline, forming the scrotal sac.

The female course of development is, in a sense, biologically intrinsic to all mammals. It is the pattern that unfolds in the absence of any hormonal influence. The male route is a modification induced by secretion of androgens from the developing testes.

The mystery of male mimicry in female hyenas may be solved by recognizing these fundamental facts of developmental anatomy. We know from the work of Racey and Skinner that female hyenas maintain high levels of androgenic hormones. We may therefore conclude that the striking and complex peculiarities of sexual anatomy in female spotted hyenas are simply, indeed almost automatically, produced by a single, underlying effect: the secretion of unusually large amounts of androgens by females.

The automatic nature of peniform clitorises and false scrotums in female mammals with high androgen levels

"Worlds" FREE!



Send your name today and we'll mail you the official "Worlds of Alaska! and Yukon" travel guide free. Allow three weeks for third class mail delivery.

Name _____
(Please print clearly. Do not used gummed labels!)

Address _____

City _____ **State** _____ **Zip** _____

☐ **For quicker delivery by first class return mail, I'm enclosing $2 and this card in an envelope to cover the extra postage and handling costs.**

Additionally, I am interested in more specific information on:

Travel to Alaska by:

1. ☐ Car, Camper, Motorhome
2. ☐ Air
3. ☐ Cruiseship from California
4. ☐ Cruiseship from British Columbia
5. ☐ State Ferryliner
6. ☐ Motorcoach or Rail
7. ☐ Hotels & Motels
8. ☐ Lodges, Resorts & Cabins
9. ☐ Tours to Alaska from U.S. or Canada
10. ☐ Tours within Alaska
11. ☐ Camping in Parks & Forests
12. ☐ Fishing
13. ☐ Sightseeing & Attractions
14. ☐ Adventure Travel (guided hiking, trekking, boating, canoe & raft trips)
15. ☐ Fly/Drive Programs
16. ☐ Guided Birding & Wildlife Photo Trips
17. ☐ Winter Sports & Vacations
18. ☐ Alaskan Food Products
19. ☐ Conventions & Incentive Travel

We would like to learn more about people who are interested in Alaska. Please help us by answering these optional questions.

20. What year are you likely to visit Alaska.
    ☐ 1981, ☐ 1982, ☐ 1983, ☐ 1984 & beyond, ☐ I'm undecided about visiting Alaska.
21. Your age. _____
22. Level of education completed.
    ☐ Grade School, ☐ High School, ☐ College, ☐ Graduate School
23. How many would visit Alaska with you. _____ How many under age 10. _____
24. I plan to travel by ☐ Group, ☐ Independently.
25. In the past 3 years have you taken a vacation trip outside the North American continent? ☐ Yes, ☐ No.

Thank you!

Natural History **412**

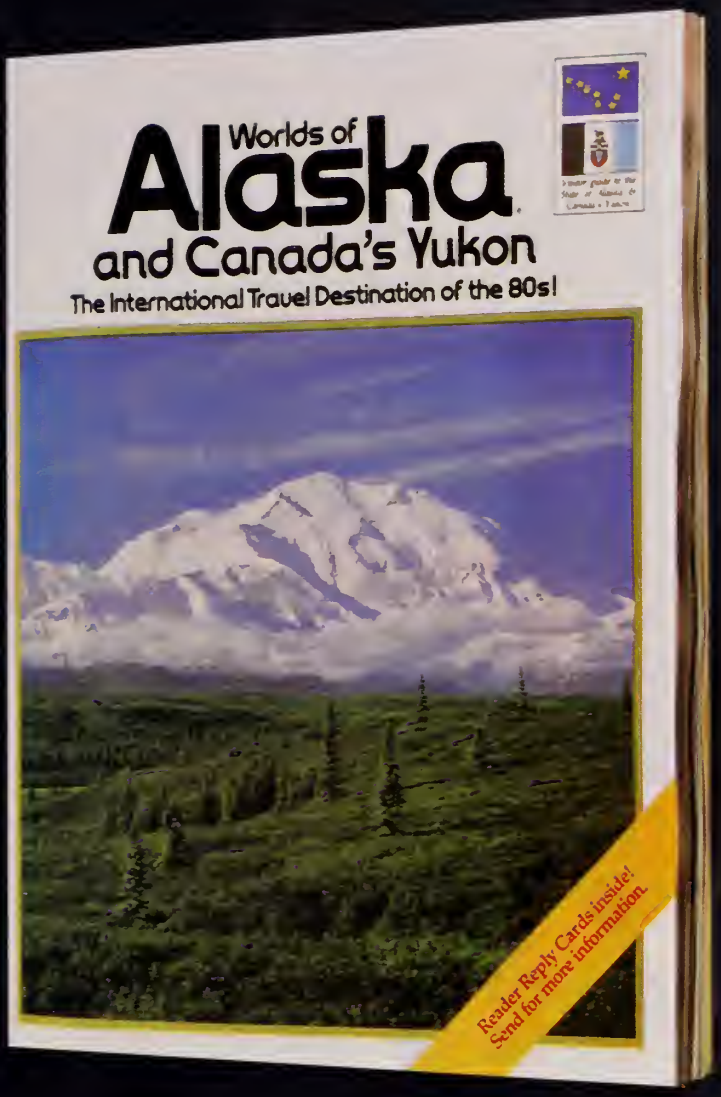
(Offer expires December 31, 1981.)

NO POSTAGE
NECESSARY
IF MAILED IN THE
UNITED STATES

BUSINESS REPLY CARD
FIRST CLASS PERMIT NO. 22, JUNEAU, ALASKA 99811

POSTAGE WILL BE PAID BY ADDRESSEE

Worlds of Alaska!®
Alaska State Division of Tourism
Pouch E-412
Juneau, Alaska 99811



If you read only one book this year, read this one.

The new 1981 edition of **"Worlds of Alaska!"** will help you plan the vacation of a lifetime.

"Worlds of Alaska!" contains 132 full-color pages of evocative description, action photography, invaluable information and thoughtful details that will help you make the most of your Alaska vacation. You'll discover all the places you want to see and all the things you want to do, carefully organized and graphically illustrated with photos, maps and charts. More than 1,200 visitor services are listed, and advertisements describe the most current offerings from Alaska's tour, transportation and lodging companies.

Read **"Worlds of Alaska!"** and discover a land of limitless adventure. You'll be ready for the best vacation ever—in Alaska!

Mail the reader reply card.
We'll send "Worlds" to you...FREE!

If the card has been removed, just write: Alaska State Division of Tourism, Pouch E-412, Juneau, Alaska 99811. (907) 465-2010



THE PEOPLE WITH MONEY ARE STILL SPENDING IT. BUT WITH INFINITELY MORE WISDOM.



We are indeed living in cautious times.

Even those fortunate enough to have a large amount of what economists call "disposable income" are disposing of it as prudently as possible.

And so one could find considerable irony in the fact that, even during the dog days of last year's crunch, the demand for BMW exceeded even the most optimistic predictions.

One could, that is, if it were not for the fact that the BMW is as appealing to those who know money as it is to those who know cars.

ENGINE TECHNOLOGY, A DECADE AHEAD OF THE COMPETITION.

In a desperate attempt to cope with the realities of the 1980's, many of the world's automakers have been forced to drastically rethink their engine technology.

Cutting cylinders, resorting to diesel fuel, tinkering with all manner of electronic devices.

Now, as any automotive expert can tell you, evolution is always preferable to revolution. So the fact that the engineers at BMW recognized the wisdom of such formerly exotic concepts as four and six-cylinder engines, sensible piston displacements and impressive power-to-weight ratios, literally decades ago, puts the BMW—and its owner—at a decided advantage.

In truth, the legendary performance capabilities of the BMW power plant are the result of years of evolutionary development—millions of miles of testing and refinement—on and off the great racecourses of the world.

STATE-OF-THE-ART ELECTRONICS.

At the turn of the ignition key, a computerized engine monitoring system (first installed by BMW in 1975) goes into operation.

With every engine revolution a computer receives and assesses signals from electronic sensors within the 6-cylinder engine itself. Then instantly determines the precise air/fuel mixture to be injected into the cylinder ports—optimizing emissions, fuel consumption and power development to a degree once considered merely within the realm of academic theory.*

THE OPTIMAL SYNTHESIS OF MAN AND MACHINE.

When you drive a BMW for the first time, you will experience a unique sensation: a total oneness with the car.

A standard five-speed transmission (automatic is available) affords the unaccountably unique opportunity to pick and choose one's own gears.

Its suspension system—independent on all four wheels—has a singular capacity for removing the drama from even the most unnerving road conditions.

Vital controls are within easy reach. The tachometer, speedometer and ancillary instruments are large, well-marked and totally visible.

RESALE: THE ACID TEST.

When all of the hyperbole has been expended, there is one brutally reliable way of determining a car's true value: how much of its original price it retains on the used-car market.

Seen in this revealing light no car in its category—not Mercedes 280E, not Jaguar XJ6, not Cadillac—equals the BMW.

According to the National Automobile Dealers Association's own 1980 used-car guide, for example, over the past 5 years the BMW 528i retained an astonishing 77.9% of its original price.

If you find the notion of owning a BMW more than a little intriguing, we suggest you phone your nearest BMW dealer and arrange a test drive at your convenience.

THE ULTIMATE DRIVING MACHINE.

BMW MUNICH GERMANY

© 198 BMW of North America Inc. The BMW trademark and log are registered trademarks of Bayerische Motoren Werke, A.G. *For example, the BMW 32 with 5 speed standard trans ers 25 EPA estimated mpg, 36 estimated highway mileage and based on these figures an estimated mpg range of 383 miles and a highway range of 551 m Natural your fuel e ency f g re for comparison purposes only. Your actual mileage and range may vary, depending on speed, weather and trip length. Your actual highway mileage and highway range w likely be wer

is confirmed by several related examples. Female spider monkeys also have an enlarged clitoris and a false scrotum produced by overgrowth of the labial folds. Although their levels of androgen have not been measured (to my knowledge), they do use their enlarged clitoris in a male form of genital display and dominance. Better examples arise from unusual patterns of development within our own species. The adrenal glands also secrete androgens, usually in small amounts. In some genetic females, adrenals are abnormally enlarged and produce high levels of androgens. These baby girls are born with a penis and false scrotum. Several years ago a drug was placed on the market to prevent miscarriages. It had the unfortunate side effect of mimicking the action of natural androgens. Female babies were born with a greatly enlarged clitoris and an empty scrotal sac formed from the fused labia.

I believe that these facts of developmental anatomy must force a revision in the usual interpretation of male mimicry in female spotted hyenas. Evolutionary biologists have too often slipped into a seductively appealing mode of argument about the phenomenon of adaptation. We tend to view every structure as designed for a definite purpose, thus building (in our imagination) a world of perfect design not much different from that concocted by eighteenth-century natural theologians who "proved" God's existence by the perfect architecture of organisms. Adaptationists might allow a little flexibility for tiny and apparently inconsequential structures, but surely anything big, complex, and obviously useful must be built directly by natural selection. Indeed, previous literature on spotted hyenas has assumed that female sexual organs evolved directly for a definite function—as in Kruuk's speculation about the adaptive advantages of conspicuous external genitalia for recognition in the meeting ceremony.

But another scenario is possible and strikes me as more likely. I don't doubt that the basic peculiarity of hyena social organization—the larger size and dominance of females—is an adaptation to something. The easiest pathway to such an adaptation would be a marked rise in the production of androgenic hormones by females (these exist in small amounts in all mammalian females). High levels of androgens would entail complex secondary effects as automatic consequences—among them, a peniform clitoris and a false scrotum (we cannot, after all, label the very same condition in some abnormal human baby girls as an adaptation). Once they are present, some use might be evolved for them—as in the meeting ceremony. But their current utility does not imply that they were built directly by natural selection for the purpose they now serve. (Yes, I know that my scenario might be run in reverse: conspicuous female genitalia are required for the meeting ceremony, are evolved by enhanced androgen levels, thus yielding large female size and dominance as a consequence. I do, however, point out that under our usual preferences for seeing direct adaptation everywhere, my scenario would not even be considered. Indeed, it wasn't in the major works on spotted hyenas.)

My columns have the nasty habit of discoursing on funny facts of natural history, and then, only at the end, reaching the general argument that inspired the disquisition. This article is no exception, for I designed it to make a point about adaptation and the evolutionary analysis of form, not as a treatise on hyena penises.

We do not inhabit a perfected world in which natural selection ruthlessly scrutinizes all organic structures and then molds them for optimal utility. Organisms inherit a body form and a style of embryonic development; these impose constraints upon future change and adaptation. In many cases, the direction that evolution takes is more a result of inherited patterns than of current environmental demands. These inheritances constrain, but they also provide opportunity. A potentially minor genetic change—a rise in androgen level in this case—entails a host of complex, nonadaptive consequences. The primary flexibility of evolution may arise from nonadaptive byproducts that occasionally permit organisms to strike out in new and unpredictable directions. What "play" would evolution have if each structure were built for a restricted purpose and could be used for nothing else? How could humans learn to write if our brain had evolved for hunting, social cohesion, or whatever, and could not transcend the adaptive boundaries of its original purpose?

In the second show of his *Cosmos* series, Carl Sagan told the tale of a Japanese crab that carries a portrait of a samurai warrior on its back. He argued that humans have built this face after their own image because local fisherman have been throwing back the most facelike crabs for centuries, thus imposing strong selection pressure for samurai look-alikes (the others get eaten). He used this example as his lead-in for a rapturous discourse on the pervasive power of natural selection.

I doubt this story very much and suspect that the conventional explanation is correct—that the resemblance is accidental and, at best, only slightly strengthened by human intervention. But even if Sagan were right, I believe that he is marveling at the wrong item (or at least failing to give equal time to another remarkable aspect of the case). I am most impressed by a crab's ability to do such an uncrablike thing in the first place—just as the capacity of an inherited developmental system to produce (and so easily) such marked changes in the sexual anatomy of female hyenas grabs me far more than any putative adaptive significance for the change.

The capacity of crabs to produce a face can have nothing to do with any selective value such a face might have since crabs do not routinely use this latent ability. It arises from several facts of crab biology: the bilateral symmetry of the carapace (corresponding by analogy with the bilateral symmetry of the human face), and the fact that many crabs are ornamented by creases along the midline (where a "nose" might form) and perpendicular to it (where "eyes" and "mouths" might be constructed).

The (probably accidental) production of a human portrait represents a stunning example of the evolutionary flexibility arising from nonadaptive consequences of an inherited design. Organic material is not putty and natural selection is not omnipotent. Each organic design is pregnant with evolutionary possibilities, but restricted in its paths of potential change. Fishermen might throw back selected starfishes with their five-part symmetry, or snails with their spiral design, for tens of millions of years and never carve a samurai into their hard parts.

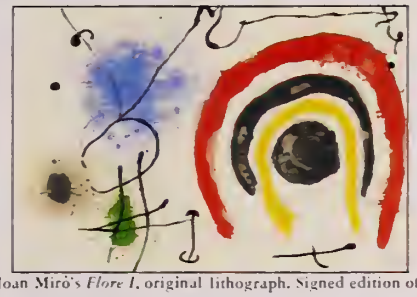
Peter Medawar has described science as the "art of the soluble." Evolution might be labeled "the transformation of the possible."

Stephen Jay Gould teaches biology, geology, and the history of science at Harvard University.

What your home could have in common with the Met, the Tate, and the Louvre



M. William Schlesinger's *Terracescape*, original serigraph. Signed edition of 195.



Joan Miró's *Flore I*, original lithograph. Signed edition of 50.



Tjelda Michas' *Oriental Poppy*, original serigraph. Signed edition of 225.



Thom de Jong's *French Dinner*, original etching. Signed edition of 175.

In your own home, you can exhibit original work by artists who are represented in the world's great museums and galleries.

Artists like Calder. Chagall. Dali. Miró. Picasso. Vasarely.

At the Original Print Collectors Group, we offer moderately priced limited edition prints by these and other well-known artists.

Our offerings include signed original etchings, engravings, lithographs, woodcuts, and silkscreen prints.

Each print we offer is signed and numbered by the artist. Custom-framed. Accompanied by a certificate of authenticity and a full money-back guarantee.

And each print has been chosen not only for its beauty but for its investment value.

(Works by the artists we offer tend to appreciate, sometimes as much as 30% in a single year. Perhaps that's why *The Wall Street Journal*, *Business Week*, *Money*, AP, *Barron's* and UPI have quoted us as an authority on investing in art.)

For more information, send in the coupon. There's no obligation.

You'll find out about the special pleasure of owning original art, instead of just visiting it.



Franklin S. Galambos' *Vanguard*, original hand-colored etching. Signed edition of 265.



Steven R. Miller's *California Flower Fields*, original serigraph. Signed edition of 300.



Jan de Ruth's *Reflections*, original serigraph. Signed edition of 200.



Nicolette Jelen's *Yellow Field*, original etching. Signed edition of 195.

Original print collectors group, Ltd. 215 LEXINGTON AVE.
DEPT. NH-27, NEW YORK 10016

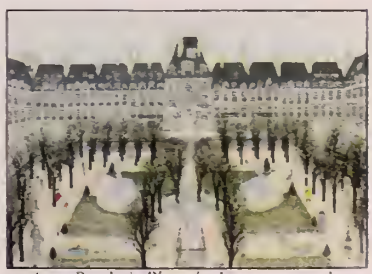
PLEASE SEND ME YOUR FREE COLOR CATALOG, LATEST NEWSLETTER AND OTHER INFORMATION

NAME _____
(PLEASE PRINT)

ADDRESS _____

CITY _____

ST _____ ZIP _____



Cuca Romley's *Place des Vosges*, original hand-colored etching. Signed edition of 150.

© 1981 OPCG, LTD



History in a lively and fascinating form . . .

The great battles that changed the course of history—portrayed on unique Sterling Silver Shields mounted in engraved cachets

Each Silver Shield will be issued in its own engraved cachet. And each cachet will be officially stamped and postmarked at the site of the famous battle portrayed—on the exact anniversary date.

An official issue of the International Military Archives, Washington, D.C.

There is a world-wide limit of just 9500 complete sets.

Agincourt . . . Orleans . . . Trafalgar . . . Austerlitz . . . Waterloo . . . Yorktown . . . The Alamo . . . Gettysburg . . . Verdun . . . Dunkirk . . . El Alamein . . . Normandy . . . all sites of decisive battles that changed the course of civilization.

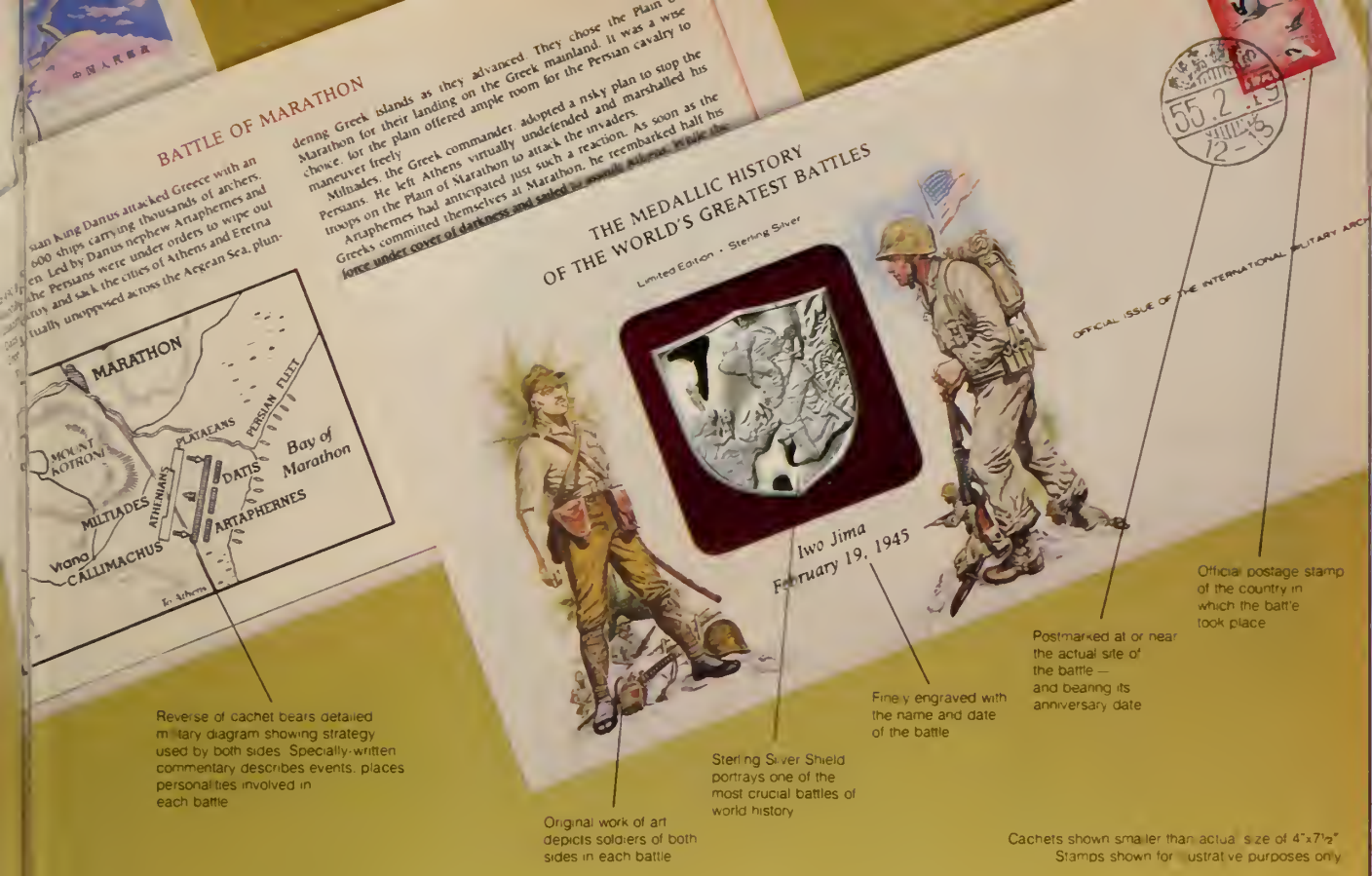
The names alone remind us that the history of the world has been shaped to a great extent by the struggle for power. But historians agree that there were *certain* battles that proved especially significant. Conflicts so worldshaking in their impact that they affected for all time the lives and fortunes of nations and peoples.

These are the great battles that will now be depicted in a new historical collection to be issued by the International Military Archives, Washington, D.C., the nonprofit association which is dedicated to the continuing study of world military history.

This collection will be *different* from any other because it will record these historical events in a distinctive form. *Sterling Silver Shields* that portray authentic scenes from the fifty most crucial battles in history.

These decisive battles include among others: Ancient Rome's greatest defeat—the Battle of Cannae—in which Hannibal destroyed virtually all the Roman fighting forces. The Battle of Hastings in 1066, which resulted in William the Conqueror being crowned King of England, the most decisive battle ever fought on English soil. The defeat of the Spanish Armada in 1588. The Battle of Yorktown, which ended the American Revolutionary War. The "Charge of the Light Brigade," one of the most infamous military adventures in history. The Battle of Verdun in World War I. D-Day—the invasion of Europe—greatest amphibious landing in world history.

Authentic scenes from these and many other great battles will be portrayed on Sterling Silver Shields created by the sculptors and engravers of The Franklin Mint. Each Silver Shield is crafted by impressing a



inely rolled sheet of sterling silver between wo matched minting dies. The result is a eautiful silver relief which captures the full cope of each battle scene in precise and ccurate detail.

Each Silver Shield mounted in an engraved cachet

o add to the educational value of this collection, each of the fifty Silver Shields will e housed in its own engraved cachet. The achet will identify the battle portrayed and ill bear an original work of art created by ne of the world's most renowned military rtists, Gerald Embleton. Each work—in ll color—will portray two soldiers, one om each side in the war represented. And ach figure will be shown in full military niform, just as he looked during the battle.

This full-color cachet art will complement the scene portrayed on the Silver hield—and provide a clearer, more vivid icture of the battle and the men who fought it.

Officially stamped and postmarked throughout the world

ach cachet will bear an official postage amp of the country in which the battle ook place. And it will be *canceled and ostmarked at the post office nearest to the tual site of that battle*. In the case of the rliest battles, extensive research was one to establish the location as accurately s possible, since even history books disgree on some of them.

Furthermore, each cachet will be *postarked on the anniversary date of the battle portrayed*. Again, in the case of the early battles, researchers have determined dates which are agreed upon by most historians in this field.

The reverse of each cachet will carry a *detailed military diagram*, showing the strategy employed by each side in the battle. In addition, a full description of the battle and a commentary on its significance will be included.

By examining each Silver Shield in its specially-designed cachet and, at the same time, referring to the military diagram and commentary—you will gain a greater understanding of the battles that changed world history. And, for younger people in the family, it will serve to enrich their understanding of these significant events.

Limited to just 9500 sets

The International Military Archives has placed a world-wide limit of 9500 sets on *The History of the World's Greatest Battles*. Once that limit is reached, all further subscriptions must be refused—and this collection will never be made available again.

Your application should be sent directly to The Franklin Mint, Franklin Center, Pa., which has been appointed by the International Military Archives to handle the distribution of the series as well as to produce the cachets. But to be sure of acquiring one of the limited number of sets available, enter your subscription promptly.

Your application should be mailed by February 28, 1981

ADVANCE SUBSCRIPTION APPLICATION

THE HISTORY OF THE WORLD'S GREATEST BATTLES

Limit: 9500 complete sets
Please mail by February 28, 1981

The Franklin Mint 20
Franklin Center, Pennsylvania 19091

Enter my subscription to *The History of the World's Greatest Battles*, consisting of 50 Sterling Silver Shields in specially postmarked cachets. The cachets will be sent to me at the rate of one per month, at the guaranteed issue price of $29.* each. I will also receive a collector's album at no added charge.

I need send no money now. I will be billed for each issue in advance of its monthly shipment.

**Plus my state sales tax*

Signature _____
ALL APPLICATIONS ARE SUBJECT TO ACCEPTANCE

Mr.
Mrs.
Ms. _____
PLEASE PRINT CLEARLY

Address _____

City _____

State, Zip _____

Note: Should the edition limit of 9500 be reached before this application arrives at The Franklin Mint, it must be returned unfilled.

The Franklin Mint is the world's largest private mint, and is not affiliated with the U. S. Mint or any other government agency.

Tropical Rain Forests: A Global Responsibility

If the world's rain forests disappear, people everywhere will suffer

by Peter H. Raven

Everyone who reads the popular press nowadays is aware of the extraordinary biological richness of the world's tropical rain forests and of the present fast pace at which they are being cut down. Less generally recognized is how little we know about the many species of tropical plants and animals and how the current destruction of the rain forests makes the need to increase our knowledge a pressing one. Of the estimated 3 million species of plants and animals in the tropics, only about 500,000 have been recognized and cataloged. In comparison, the temperate regions of the world contain some 1.5 million species, of which more than a million have been cataloged. A large majority of virtually every known group of organisms occurs in the tropics, making tropical forests the richest and most diverse association of plants and animals anywhere on the earth. About as many kinds of plants exist in the tiny country of Panama, for example, as in the entire continent of Europe, and nearly as many kinds of fishes—some 5,000—live in the drainage basin of the Amazon River as in the whole Atlantic Ocean. The diverse kinds of plants and animals in the tropics represent a potentially inexhaustible source of raw materials, only a minute fraction of which has been utilized or even tested up to this point.

The organisms that make up the ecological communities of the tropics are linked together in extremely complex ways. Fundamental processes such as energy flow and mineral cycling, which are complex and poorly understood even in temperate regions, are virtually unknown for the tropics. We do know that the rich and diverse communities of plants and animals that occupy tropical soils are relatively stable when undisturbed. They have remained stable for millions of years and are as appropriate to the climate and soils of their areas as the forests, swamps, and prairies in the United States are to theirs. When farmers plow up a prairie in the Midwest to plant crops, they are modifying a natural ecological system in order to create another productive, sustainable system. When agriculturists cut down a forest in the humid lowland tropics, they are often trying to accomplish the same thing. The many differences between the ecological processes involved in the two instances, however, have potentially tragic consequences for a large and rapidly growing portion of the human race. Once the sorts of forests that occupy most tropical areas are cut down, a reasonable agricultural yield is usually possible for only a few years. The cutover area, depleted of its fertility, often becomes a wasteland, with restoration to its original state or to use for any productive purpose virtually impossible.

Our ignorance about ecological processes in the tropics is compounded by our general lack of knowledge about tropical organisms. Although the vast majority are insects, mites, nematodes, fungi, and other relatively small organisms, we also have a great deal to learn about many species that are larger and belong to groups that are more familiar. To give just a few examples, some ten to fifteen thousand kinds of plants in Latin America, including many trees, have not yet been scientifically described and listed. These plants, which constitute perhaps an eighth of the total plants in Latin America, are generally viewed as a valuable resource, but as long as they remain unknown, they cannot be utilized rationally for human benefit. Similarly, many people are counting on manipulating the populations of fishes in the Amazon Basin and its tributaries as a way of increasing food production in the future. Competent students estimate, however, that approximately 40 percent of these fishes have not yet been recognized and

---

Director of the Missouri Botanical Garden in Saint Louis, Peter H. Raven served as chairman of the National Research Council's Committee on Research Priorities in Tropical Biology. Composed of scientists from many countries, the committee was concerned with the rapid destruction of the world's rain forests and the need to acquire basic scientific knowledge about tropical organisms and ecosystems. Last year, Raven presented some of the committee's findings before the Subcommittee on International Organizations of the House Committee on Foreign Affairs. This article is adapted from his remarks.



HISTORY REPEATS ITSELF

Again, we're only $15 a year

History repeats itself in the new year by offering you membership in the Museum of Natural History and 12 galvanizing issues of NATURAL HISTORY Magazine at last year's low price of just $15.

☐ YES, send me 12 months of NATURAL HISTORY for just $15 (I save $9 over the newsstand rate) and my museum membership which is included in my subscription.

NAME _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

I PREFER TO INCREASE MY SAVINGS AND ENJOYMENT:
☐ Send 2 years at $26 ☐ Send 3 years at $35

Include a gift membership for:

NAME _____

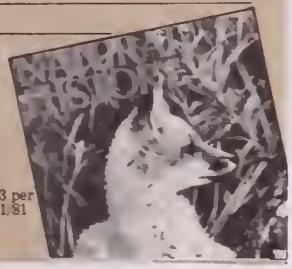
ADDRESS _____

CITY _____

STATE _____ ZIP _____

NATURAL HISTORY Magazine is published by the American Museum of Natural History, New York, N.Y. Please allow 7 weeks for delivery of first issue. Outside U.S. please add $3 per year for postage. Offer void after 7/31/81

J463



NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO. 30 BERGENFIELD, NJ

Postage will be paid by addressee

NATURAL HISTORY
P.O. Box 4200
Bergenfield, New Jersey 07621

cataloged. In other words, hopes are pinned on manipulating a system in which only somewhat over half of the elements have been registered, much less understood. Imagine trying to build a computer or an airplane from such a starting point!

Another example of how little we know about tropical ecosystems concerns the basic coupling relationships known as mycorrhizae. These symbiotic associations of fungi and the roots of trees are of essential importance in the recycling of minerals in tropical forests and hence in the stability and proper functioning of the forests themselves. The coupling is so tight that only a thousandth of the nutrients that reach the top layer of leaves on the forest floor penetrates even as much as two inches to the subsoil beneath. Understanding mycorrhizae is crucial to any successful conversion of these forests for other productive purposes; yet, how the relationships function has been demonstrated experimentally only within the past five years. Small wonder that our efforts to manipulate tropical forests for human advantage have so often met with total failure.

Greater knowledge about the tropics is certain to result in many discoveries that will promote human welfare. Approximately 45 percent of the medical prescriptions currently written in the United States, for instance, contain at least one product of natural origin, and as-yet-unknown plants might well contain chemicals that would assist in the cure for cancer. In addition, many of the important

Q. What is the WEBSTER'S NEW UNABRIDGED 20TH CENTURY DICTIONARY about?



A. It's about 2,300 pages and more than 4 inches thick!

For more than 40 years Webster's Unabridged Dictionary has served as an invaluable reference for students, teachers, businessmen, secretaries . . . and workers in all trades and professions. The reason is simple. Here is a dictionary that supplies the need for accurate and full definitions, correct spellings and pronunciations, full etymologies, synonyms, as well as other general and specific information.

A large staff of lexicographers and linguists has painstakingly edited and updated each definition so that it is clear, accurate, and readily understood in all its senses. Many new entries have been added, including recent additions to the language in the natural and social sciences, the humanities and other specialized branches of human knowledge.

un à bridged', *a.* not shortened; complete; specifically, designating a dictionary that has not been abridged from a larger work.
un ac cent'ed, *a.* not accented; specifically, in

The large, clear, legible type shown above (actual size) "makes this unabridged dictionary the most readable one in print."

. . . now own one of the finest reference books in the world at only ⅓ of its originally published price.

NEW DELUXE COLOR EDITION — **Includes Thousands of Illustrations Along With 32 Full Color Pages Plus a Full Collection of the Maps of the World**

Plus it contains these important supplements!

1. A Dictionary of Biography
2. A Dictionary of Geography
3. A Dictionary of Noted Names in Fiction, Mythology, Legend
4. A Dictionary of Foreign Words and Phrases
5. A Dictionary of Scripture Proper Names and Foreign Words
6. Abbreviations Commonly Used in Writing and Printing
7. Practical Business Mathematics
8. Forms of Address
9. Tables of Weights and Measures
10. Special Signs and Symbols
11. Presidents of the United States
12. Vice Presidents and Cabinet Officers of the United States
13. Declaration of Independence
14. Constitution of the United States
15. History of Canada
16. Charter of the United Nations
17. Air Distances between Principal Cities
18. Principal Geographic Features of the World
19. Commercial and Financial Terms

BARNES/SALE & NOBLE/ANNEX — SAVE $40

MAIL ORDER WD348
126 FIFTH AVE., N.Y.C. 10011

PUBLISHED AT $59.95
NOW ONLY $19.95

Please rush me ___ *Webster's New Unabridged Dictionary* at your special sale price of $19.95 (plus $3.00 postage and handling). N.Y. Residents Add Sales Tax

Mr ☐ Ms. ☐
NAME (Please print clearly)
ADDRESS
CITY ZIP

For Faster Service
CREDIT CARD HOLDERS CALL FREE 800-228-2051 /EXT.15
24 HOURS 7 DAYS-A-WEEK
In Nebraska call 402-571-4900

© 1980 Barnes & Noble Bookstores Inc

THE BARNES & NOBLE MAIL ORDER GUARANTEE
Every book you purchase from Barnes & Noble by mail must meet your standards. If not... return it for a full refund within 30 days or credit to your charge account.

In business for 105 years, Barnes & Noble has become "the world's largest bookstore" (See the current Guinness Book of World Records.) Our goal is to sell the finest books in the world at the lowest possible prices. Ask about us at your local school or public library.

I prefer to charge this purchase: ✓Check One
AMERICAN EXPRESS Card ☐ VISA ☐ master charge ☐
master charge 4 digits above your name

Account# Exp.
Signature

crops of the world have been brought into cultivation only recently. One example, the oil palm, widely cultivated only for the past fifty years, is now a multibillion-dollar industry.

In contrast to potentially useful wild organisms, many unknown species are potentially harmful. The brown leaf hopper, for example, is a small insect that caused several billion dollars of damage to rice crops in Southeast Asia during the past five years and reduced millions of people to starvation. A member of an insect group comprising more than 20,000 known species, which can be identified competently by only about a dozen people in the entire world, this pest was virtually unknown until it appeared by the billions in the rice fields of Southeast Asia three years ago. The pressure from pests and diseases in the tropics is generally so great that growing single crops in pure stands over any but the smallest areas is very difficult. Many such obstacles stand in the way of creating productive agricultural systems or reforestation projects similar to those that are common in temperate regions, and without basic knowledge of tropical plants and animals we will be unable to understand the potentially harmful ones well enough to prevent their depredations on crops and domestic animals.

Against this background, the tiny effort that is being undertaken to learn more about tropical plants and animals and the natural communities in which they live is embarrassing. Worldwide, there are no more than an estimated 4,000 scientists primarily concerned with studies of this kind; the total in the United States amounts to some 1,500 individuals. Probably no more than 1,500 scientists in the world are able to catalog and describe tropical organisms or are even competent to make professional identifications of them. The number of unknown tropical organisms—five out of six have never been seen by any professional student—amounts to a staggering total of some 2.5 million species, or about twice as many as all species described during the past 225 years.

An even smaller number of scientists throughout the world—no more than two dozen—are competent to supervise and undertake large-scale studies and experimental modification of tropical ecological systems. Of the handful of these individuals in the United States, no more than three are engaged in tropical studies at present. Notwithstanding this great lack, the ultimate success of every forestry and agricultural system being proposed for the tropics rests on an understanding of the functioning of the undisturbed ecological systems that are being replaced.

Gaining this understanding will cost money. Yet in the United States, the total expenditure in fiscal year 1979 for basic tropical biology was no more than $20 million. This small sum almost certainly represents more than half the total global funding; the tropical countries themselves are rarely able to divert significant amounts of money into research or even development. The collective human effort to learn more about tropical plants and animals and the associations in which they occur is very limited indeed.

The extremely serious nature of these deficiencies can be understood properly only when viewed against the background of tropical deforestation. The lowland tropical forests, which a century ago made up an area twice the size of Europe, have been reduced to about half their former extent. Every week, the remaining tropical lowland forest diminishes by an area about the size of Delaware, and every year, an area about the size of the island of Great Britain is removed. Such a rate of destruction, if applied uniformly around the world, would result in the disappearance of all unaltered tropical forest in approximately thirty years, but of course the rate is not evenly distributed. The National Research Council's Committee on Research Priorities in Tropical Biology, which published its report in June of 1980, estimated that within twenty years the only surviving extensive tracts of undisturbed tropical lowland forest will be those in the western Brazilian Amazon region and in Zaire in central Africa, and that even these will be altered and deforested during the first ten to twenty years of the twenty-first century.

This process of alteration is essentially irreversible for several reasons. First, it is closely connected with population growth in tropical countries, the great majority of which are growing so fast that their populations will double within twenty-five years. Since between 40 and 50 percent of the present population in most tropical countries consists of individuals less than fifteen years of age, even the immediate adoption of consistent and sustained population-control policies would not produce a stable situation until the latter part of the twenty-first century. By that time, the world would have a population of some 16 to 18 billion people, or about four times the present number. Second, the patterns of land use in tropical regions are such that only a very small proportion of the land is used to feed the hungry poor. In the United States, 7 percent of the landowners own 27 percent of the arable land. In Latin America, by contrast, 7 percent of the landowners possess 93 percent of the arable land, and since most of this land is planted with cash crops and export crops to earn foreign credit, the remaining 7 percent of the land must produce sufficient food for the vast majority of the people. International commerce, which guides the exploitation of the 93 percent of the land controlled by large landowners, plays a significant role in structuring the economies of tropical countries.

Poor people, denied access to arable land, cause about two-thirds of all destruction and alteration of tropical forest. These forest farmers cut out a section of forest and grow a crop or two before the soil deteriorates to the point where cultivation is no longer feasible. A variety of other factors are responsible for the remaining destruction of tropical forests. In Southeast Asia, the wholesale exploitation of forests for timber by foreign-owned corporations, which make little more than a gesture toward the replacement of the forests, is the major factor. In Latin America, the relentless effort to produce cheap beef for the United States and other developed countries is causing the disappearance of vast areas of forest. Ironically, while more than a quarter of all the forests in Central American countries have been destroyed in the past twenty years to produce beef for the American market, the average consumption of beef in those countries has declined steadily during the same period.

When they learn that tropical forests are rapidly disappearing, many people accept the destruction as warranted since they believe it will lead to the implementation of productive forms of agriculture that will help feed the hungry people of the world—much as the clearing of the forests in Europe and North America made possible the wide spread of productive agricultural systems in these regions over the cen-

Do you have room in your home for three wise men? They are Plato, Aristotle, and Marcus Aurelius...three of the wisest, wittiest, most stimulating minds that ever lived.

They still live...in the Five Great Dialogues of Plato, the Meditations of Marcus Aurelius, and Aristotle's On Man in the Universe.

All three books (regularly $22.17) can be yours for only $1.00 as your introduction to the Classics Club.

The Classics Club is quite unlike any other book club.

The Club doesn't offer best sellers that come and go. Instead, it offers its members a chance to stay young through great books that will never grow old. These books include Utopia by Thomas More; the works of Shakespeare; Benjamin Franklin's Autobiography; Omar Khayyam's Rubaiyat; Walden by Thoreau; and other fresh, spontaneous, even outspoken works that stretch your mind and sweep away the mental cobwebs that hold back most men.

You never have to buy any of these books. (To force you to buy a classic would be barbaric.) As a member, take only those books you really want to own. And, at any time, you may cancel your membership, without penalty or hurt feelings.

The selections themselves are remarkable values. They're carefully printed on expensive paper stock. They're hard-bound in matched wheat-colored buckram, worked and stamped in crimson, black, and 23-karat gold. And through direct-to-the-public distribution, we are able to offer our members these deluxe editions for only $7.39 each, plus shipping.

Interested? We'll send you the first three selections, Plato, Aristotle and Marcus Aurelius – all three for only $1.00 plus shipping.

We know what charmers these three wise men are. We're betting that you'll be so taken by them that you'll want to stay in the Club and meet some of their friends, including the greatest story tellers, philosophers, poets, and historians the world has ever known.

Don't send any money now. We'll bill you later. Just fill in the coupon below, now, while you're thinking about it and while the invitation still stands.

Mail coupon to The Classics Club, Roslyn, New York 11576.



LET THESE 3 WISE MEN INTO YOUR HOME.

LATER, YOU MIGHT LIKE TO INVITE THEIR FRIENDS.

THE CLASSICS CLUB ROSLYN, N.Y. 11576

Please enroll me as a member and send me at once Plato, Aristotle and Marcus Aurelius. I enclose *no money now*. After a week's examination, I will either keep my books and pay $1 (plus shipping) or return them. As a new member, I will get a complete list of titles from which to select the books I want. For each volume I choose, I pay only $7.39 (plus shipping). I may return any book, for full credit within 21 days and I may cancel my membership at any time. Note: Members accepted in U.S.A. and Canada only. Offer slightly different in Canada.

MR./MRS./MS. _____
(PLEASE PRINT) CO2D3G

ADDRESS _____

CITY _____

1-NX

STATE _____ ZIP _____

turies. Unfortunately, the comparison is totally without basis in fact. The current estimate of many Brazilian officials, for example, is that with currently available technology, only approximately 0.3 percent of the vast lowland forests in the Amazon Basin can be put into sustainable agriculture; about 95 percent of all the land in Brazil that is capable of sustained agricultural productivity is already under cultivation. The country now has some 90 million people, of which about a third are malnourished. Since the population is expected to double during the next twenty-three years, how malnutrition could be held even at the same proportionate level as it is today is unclear. Indeed, if the plans of the Brazilian government to alleviate the nation's acute energy shortage by planting sugar cane for the production of alcohol are implemented, approximately one-sixth of the currently productive agricultural land of Brazil could be taken out of production, a sacrifice that surely cannot be sustained in a country where a very large number of people are malnourished.

One of the most unsuitable purposes for which the tropical forests are being cut down is beef production. The kinds of cattle ranches that have been developed with such enthusiasm throughout Latin America during the past twenty years have proved ecologically unstable. The fertility of the ranch soils declines over a period of ten to twenty years until profitable cattle production is no longer possible. For most tropical soils, fertilizer—even when funds can be found to purchase it—does not restore fertility. Under the influence of the beating tropical sun and high precipitation, the structure of many tropical soils simply disintegrates, rendering them unable to retain nutrients. A number of tropical soils harden into cementlike layers, called laterites, that are impervious to the plow and essentially useless for agricultural purposes. Only much greater attention to understanding how undisturbed tropical ecological systems function and—through experimental manipulation of these systems—to finding ecologically suitable productive agricultural systems will succeed in alleviating such problems. Intercropping, for example, which involves the growing of several different kinds of crops together, will probably prove to be more stable in the tropics.

Regardless of whether they are developed wisely or unwisely, tropical forests are being cut down, and if their destruction and conversion is indeed irreversible, approximately one million kinds of plants and animals, or one-quarter of all that exist, will become extinct during the next thirty years, and possibly another million during the course of the twenty-first century. Such a rate of extinction is postulated on the destruction of the natural communities in which these plants and animals occur and also on the inability of many of these organisms to reproduce outside undisturbed tropical forest. The loss of biological diversity in the tropics as a result of these extinctions will have serious consequences for the human race. Every species is genetically unique. We cannot study an extinct species, we cannot use it, and we cannot develop it into something more useful.

Current conservation efforts, unfortunately, still tend to concentrate on a few obvious or well-known plants and animals, such as the Furbish lousewort, the snail darter, the elephant, or the tiger, while tens of thousands of other species go extinct without fanfare. Probably twenty times as much is spent annually to try to preserve the roughly thirty surviving California condors as is spent to find new kinds of tropical plants that might be important sources of food, fuel, or medicine. We must ask ourselves which kind of action has the greatest potential for alleviating human misery and helping to create a stable world.

By the end of this century, three-fifths of the world's population will be living in the tropics, and one-fifth in China. The remaining fifth will include all those people in the United States, Canada, Europe, the Soviet Union, Japan, Australia, New Zealand, temperate southern Africa, and temperate South America. The proportion of people living in the tropics will become progressively higher during the course of the twenty-first century. The projected picture for the world's tropical regions is by no means a promising one: current technology has not found a way to bring into cultivation more than 5 percent additional arable land in the tropics; the world's fisheries are badly depleted and declining; the roughly 400 million people who now make a living by clearing and farming small plots in tropical forests will have doubled in number and be essentially without any place to turn by the end of the present century; there is no obvious source for energy in most tropical countries other than burning up their forests, displacing productive agricultural systems with energy-producing crops, or developing their nuclear capabilities; and the total excess food productivity possible in temperate regions will be patently unable to feed the roughly 125 million people that will be added to the populations of tropical countries each year during the first part of the twenty-first century.

What happens in the tropics affects the entire world. For example, the shortages of many kinds of commodities, which developed countries formerly obtained from the tropics at very low prices, are already contributing to worldwide inflation and hence instability, and they will do so to a greater extent in the future. As a matter of self-interest and national security, all temperate, developed countries ought to begin to contribute substantially to the development of sustainable productive agricultural and forestry systems in the tropics.

We in the United States must adequately fund appropriate programs to learn more about tropical ecosystems and about how to use this knowledge for human benefit as directly as possible. To do this, we must take steps to increase the number of scientists competent to deal with such problems, both in the United States and in the countries directly concerned. Legal authority to conduct programs overseas must be granted to branches of government, such as the Department of the Interior, that can make a strong contribution in this area. Agencies such as the National Science Foundation and intergovernmental efforts such as the United Nations Man and the Biosphere Program, which have proved their ability to conduct studies in environmental biology, must be granted greatly increased funds for tropical research. In its foreign-aid programs, the United States must pay more attention to the importance of building up the research capabilities of the tropical countries themselves.

The countries of the world, developed and undeveloped, can prosper and exist in peace only in a relatively stable world. If we are to enjoy the benefits of global stability during the next century, indeed if we are to survive, we must seize the opportunities that are still available to us but which are diminishing every day. □

The 1981 Natural History Photographic Competition Is Open



The Grand Prize-winner this year will have a rare opportunity to photograph exotic wildlife with a close-up lens. And the winner may not even be a photographer. Let us explain about the special 1981 contest:

The Grand Prize will be an eleven-day trip, including airfare from New York and a berth on the yacht *Buccaneer*, to the Galápagos Islands. Many fearless creatures on those islands let photographers walk right up to them. The tour, sponsored by the American Museum of Natural History, will be led by two Museum scientists.

Seventeen cash prizes, totaling $3,500, will go to winners in seven categories, including a special new one, Historical Photographs. In this category, you need not be the original photographer, but you do have to own the picture and it should be more than fifty years old. So search your attic and old albums for prize-winning pictures that fit our three major categories.

The three major categories are Animals (including birds and bugs); Plants and Their Environment, and The Human Family. First prizes of $500 will be awarded in each.

In addition, Merit Awards of $250 each will go to the best entries in four categories: Photomicrography; A Sequence in Nature (up to five photographs); Historical Photographs; and Humor in Nature. Ten Honorable Mentions of $100 each will be selected from all entries.

The winning entries will be published in the July issue of *Natural History* and exhibited at the American Museum of Natural History.

THE RULES

1. The competition is open to everyone except employees of the American Museum and their kin.
2. Competitors may submit up to five previously unpublished entries (a sequence is considered a single entry).
3. The Museum acquires the right to publish, exhibit, and use for promotion the winning photographs. The Museum assumes no responsibility for other entries.
4. Entries may be transparencies or prints, either color or black and white, up to 8 by 10 inches. Each must bear the photographer's name and address. Entries must *not* be mounted in glass.
5. Enclose a self-addressed, stamped envelope for the return of entries.
6. Entries must be postmarked no later than April 1, 1981.

Pack them carefully and mail them to:

Natural History Photographic
Competition
11 West 77th Street
New York, New York 10024

And good luck!

Children of the Hutterites

The goal of child rearing is voluntary submission of the will to the community

by Gertrude Enders Huntington

"All of us have by nature a tendency toward evil and to have pleasure in sin. . . . Children, however, know neither good nor evil."

Account of Our Religion, Doctrine and Faith Given by Peter Rideman, 1565

In 1963, when I embarked on a series of field studies in a Hutterite colony in Canada, I did not realize how very different the child-rearing practices of this communal Christian sect would be from those taken for granted in the New England college community in which we had been living. Otherwise, my husband and I might not have been so sanguine about taking our three children to an isolated, German-speaking community in which they would be immersed in a socialization process so thorough that it has maintained the Hutterite culture through some 450 years of persecution and protection, hardship and affluence.

My mother, a child psychologist and elementary-school teacher, came with us to the colony. The children had had little preparation other than time spent on Amish farms—and the family-centered culture of the Amish proved to be no preparation for the communal childhood they were about to experience. The Hutterite culture is rigidly age graded; not even as a child had I so often been asked, "How old are you?" Our three-generational family had a member in every age category except adolescence, but our fifth-grade daughter, because of her wider experience, was admitted to the edge of the adolescent's private world. As the oldest person in the colony, my mother was called grandmother by everyone. She was identified with the three grandparent couples. My husband and I were in the middle generation. Each of our children was in a different category: Abigail, nine, was a "German school" child; Daniel, who had his fifth birthday in the colony, was a kindergarten child; and Caleb, two, was a house child. Thus it was natural for us to participate in the various socially defined age grades and to experience personally the socialization process.

We were assigned a two-room house about forty feet from the nearest family (with whom we shared an outhouse) and about sixty feet from the nearest "long house," consisting of apartments for four families. The center of the colony had the feeling of a medieval village. It was bounded on one end by the communal kitchen, which housed the dining room, bakehouse, washhouse and bathhouse, and at the other end and slightly to one side was the public-school building, which was also used for German school and the daily church services. All buildings related to home and family were painted white with blue trim; those that served an economic function were usually painted red. All living buildings were built true to the compass, running due north and south or due east and west; the floor plan of the living houses has changed little since the sixteenth century.

The uniformity of the color and architecture, the physical proximity of the buildings, the grassy commons, the flowers around the houses, and the neat walks proclaim visually the orderly existence of the inhabitants. Time is measured out as discretely as space, and there is a proper activity for each moment of the day, each day of the week, each season of the year, and each stage of one's life. An individual's dress establishes sex, age, activity, and obedience to the rules of the colony. When it became evident that we were not simply visitors but participants, we were urged to take off our "ugly" clothes and put on Hutterite attire. The dress signified our willingness to accept our age- and sex-determined position in the colony and to abide by the rules. We became a part, first, of the visual environment, then of the behavioral environment, next the emotional environment, and finally, we almost became a part of the intellectual environment, usually





Jim Welch

understanding but never quite internalizing the Hutterite world view.

This failure at the last step did not prove an insurmountable problem both because we were not permanent members of the community and because the Hutterites stress correct behavior over correct thinking. Their catechism asks, "What is inner shame?" The reply is, "When a man has sinful thoughts, which he should dispose of." It asks, "What is sin?" The answer is, "The transgression of the law." In a communal society, wrong thinking is bad, but if kept to oneself, is not disruptive; wrong behavior, no matter what the motive, is sin. And as participants, we were not to sin. We were helped to be good, for as the minister gently assured us, "You are fortunate to be living in the colony, for there are always one hundred eyes watching you."

The Hutterites, or Hutterian Brethren, live in discrete colonies on the plains of the United States and Canada. They migrated to the United States from Russia in 1874, having, it is claimed, been assured by President Grant that their absolute pacifism would not cause any trouble because "America would never fight in another war." Of the eight hundred Hutterites who came, about half took advantage of the Homestead Act and finally settled in dispersed family units; the other three to four hundred settled in three colonies in South Dakota. Through biological increase and by an orderly process of establishing daughter colonies, the population has grown to about 24,000, and the original three colonies have become 230. Today, colonies are located in Alberta, Saskatchewan, Manitoba, North and South Dakota, Montana, Washington, and Minnesota. Theologically, the Hutterites are Anabaptists, practicing adult baptism, total nonresistance, and apostolic communism. They trace their origin to a moment in the spring of 1528 when a cloak was spread before a group of religious refugees fleeing through Moravia, and each member of the group laid upon it his money and other worldly possessions. Thus, occasioned by necessity and sanctioned by religion, the practice of "all things in common" (Acts 2:44) was adopted as the Hutterite way of life. They called themselves Brothers, but were named Hutterians or Hutterites by outsiders after an early leader, Jacob Hutter, who was burned at the stake in Innsbruck in 1536. A minister's translation from the *Geschichts-Buch*, a history book kept by the Hutterite leaders through the centuries, describes Hutter's ordeal:

> After they had him captured, they tied a club in his mouth and transferred him to Innsbruck. They punished him and tortured him but he would not recant.... They proceeded to put him in ice cold water until he could not move. From there they put him in a warm room and lashed him unmercifully. They cut wounds into his body and poured alcohol into the wounds, lit it, and let it burn. But still he would not recant. After much suffering and torture, he was sentenced and burned at the stake alive.

The persecution of the Hutterites did not subside until 1551. By 1592, there were approximately ninety colonies in Moravia with an estimated population of twenty to thirty thousand. But by 1767 renewed persecution, war, and the Counter-Reformation had reduced their number to nineteen. This handful, joined by fifty-six Lutherans from Austria, fled to Russia, where they settled in 1770. When denied exemption from military service and the right to maintain their own schools in 1874, they emigrated to the United States. There conditions were favorable until the outbreak of World War I, when the Hutterites were harassed by their neighbors and Hutterite draftees were subjected to barbaric treatment. After months in solitary confinement, two North Dakota Hutterites who had refused to wear army uniforms died of physical mistreatment, malnutrition, and pneumonia. When the wife of one of the men asked to see his body, she was shown it—dressed in the military uniform he had so steadfastly refused to don. As a result of this episode, most Hutterites moved to Canada, where the majority still live. The men who died in prison during the First World War are remembered as martyrs to their faith.

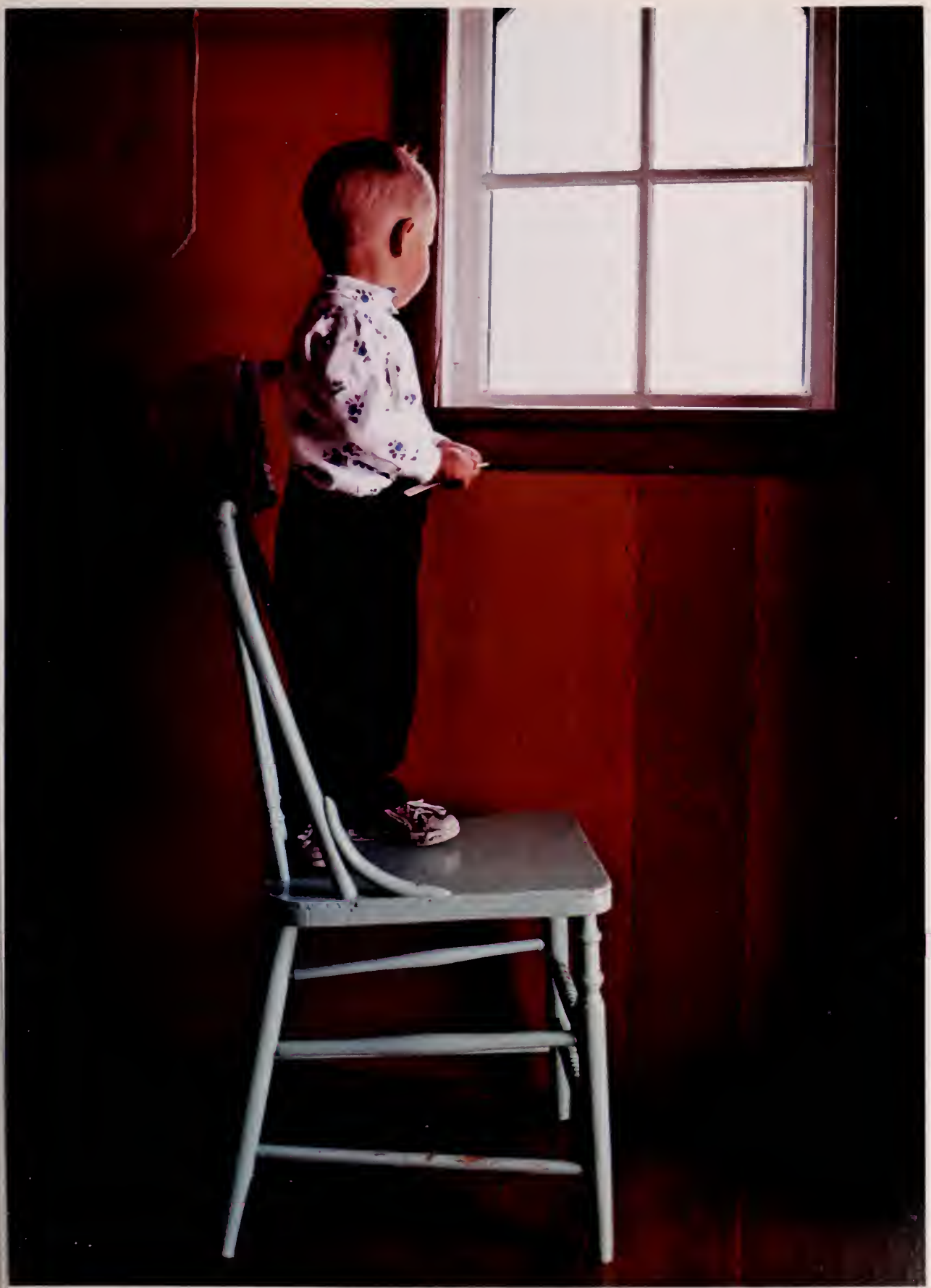
Hutterites do not stress historical dates or even historical sequences, but stories of the martyrs and times of tribulation are copied by children in German school and are retold at informal gatherings where the children learn, and the adults remember, that it is better to "die the bitterest death, yea ten deaths, than to forsake the truth." Retelling their history reinforces their belief in the sinful and corrupt ways of "the world," their belief that this life is difficult and arbitrary and the true Christian must expect to suffer for his faith. The Hutterites have never believed their life to be utopian, viewing it instead as an exacting religious regimen that demands denial of self and of private property and absolute obedience to God and the community. A Hutterite work describes "a way of life that not even we who live it, always like, according to the flesh; but we know it is . . . the way the God of love wants his children to live on this earth. . . ."

The goal of child rearing among the Hutterites is the young adult's voluntary decision to submit himself to the church community. The Hutterites have been remarkably successful in achieving this goal by guiding their children through a series of socially defined age grades, each characterized by specific behavior and teaching.

During the first three years of life, the Hutterite child is known as a baby, or a house child, because it is fed at home and is primarily under the care of its parents. This is a privileged period in the individual's life and a time of intense socialization. Although little attention is paid to pregnancy, other than to maintain that the harder a woman works, the healthier her baby will be, and the role of the mother in the birth is de-emphasized (babies are viewed as a gift from God), the neonatal period is a very special time for both mother and child. The new mother is relieved of all colony responsibilities and given the full-time help of a mature woman. Typically, the woman's own mother comes from her home colony to care for and mother her daughter, who, in turn, cares for and mothers her new baby. The caretaker-nurse feeds and cares for the mother and her house children, does all her family work, and even sleeps with her at night, helping her twenty-four hours a day. Colony members and relatives from neighboring colonies come to visit the mother and to see the new baby.

Hutterites consider the neonatal child demanding and vulnerable but at the same time a great joy and a

During the first three years of life, the Hutterite child is known as a baby, or house child. House children are fed at home and are primarily cared for by their parents.



Craig Aurness

pleasure to care for. The mother is confident of her ability to supply her baby's needs and enjoys nurturing the completely dependent child. The baby wears a cap on its head, is swaddled with a blanket wrapped over its clothes, and is tied into a firm, straight bundle with a narrow cord woven just for this purpose. Swaddling is said to make the baby easier to handle and play with (that is, less easily injured and more enjoyable). A red ribbon or cord is tied onto the baby to protect it from the evil eye, from being fussy, from having colic. Its widespread use indicates the vulnerability attributed to small babies. When the child is four weeks old, the mother's caretaker leaves and the father takes over the nighttime care of the baby. For two more weeks the mother is relieved of colony work, then she is gradually reintegrated until, when the baby is thirteen weeks old, she resumes cooking for the colony and once again becomes a full participant. For the next three years, the colony schedule determines the time the baby will be fed, the time it will be played with, the time it will be left alone, and the time it should sleep.

Everyone in a Hutterite colony loves a baby. Children of both sexes will crowd around a baby to play with it. A child as young as two will be rewarded by being allowed to hold an infant. When the adults, especially the men, are not working, the babies are always held, and everyone who passes a very young child—adult Hutterites, colony members, and visitors—gives it cheerful attention. The baby is spoken to, picked up, tickled, played with. However, when it is time for church or the adult meal, the baby is promptly placed in its crib and the parents walk out. After seven weeks of age, a baby is always either in a socially stimulating environment or alone in its crib.

A child is believed to be completely innocent until it is observed to strike back or to pick up a comb and try to comb its hair. Either of these activities is believed to indicate that the child's level of comprehension is sufficiently high to understand discipline. The child is displaying self-will and understanding. If house children quarrel over an object, the object is removed; if they are quarreling for another reason, they are often told to kiss one another. Very young children will hit each other and then immediately hug and kiss, avoiding adult displeasure by quickly making up. An older house child may be strapped for refusing to go to someone other than its parents, for refusing to share food, or for being noisy and disturbing adults. Immediately after punishment, the crying child is comforted.

Hutterite women almost never take their house children with them when they are doing colony work. If the mothers are busy, the older toddlers, especially the boys, accompany their fathers and play near the place where the men are working, usually in the company of the youngest schoolboys. There is a united effort on the part of the colony, in which the parents cooperate, to wean the house children away from their parents and into the group. Most of the activities that are considered especially pleasurable, such as riding in a wagon or on the back of a truck, can be enjoyed only if the toddlers will leave their parents to join in the fun. When the little ones are in a group of children, however, they often become the butt of aggressive teasing.

House children are socialized to like people and to respond positively to every person (or at least every Hut-



Craig Aurness

Kindergarten girls prepare for their nap. Three- to six-year-olds spend the entire day in kindergarten and of all age groups, experience the most restricted, most regimented, and least varied program.

Robert Weinreb



A baby's schedule becomes adjusted to that of the colony. An older child is assigned the task of baby sitter when the mother is occupied with colony work, eating, or attending church services.

terite) who comes within sight or earshot. They are taught to be aware of, and to respond quickly to, the wishes of others, but they are also taught not to initiate contact or disturb them. It is difficult to know what factors influence a child's development, but certainly Caleb, the house child we brought to the colony, has turned into an adaptable person who is comfortable with people and intuitively responsive to those around him. When we returned to New England and he began nursery school, he never spoke above a whisper in front of strange adults, but played happily with the children. He was a master at avoiding quarrels. By the time he was in kindergarten, he still rarely initiated contact, but college student observers reported he was the most sought-out child in the group. Caleb, who was at a socially favorable age stage, responded most positively to the Hutterites. For months, he asked daily when we would go back to live in the colony, and he has enjoyed each return visit, stepping naturally into the proper age- and sex-determined niche.

"Our kindergarten school is from three to six years. Here they learn to obey, sing, sleep, memorize, and pray together," explained a Hutterite minister. "We need the kindergarten," remarked a Hutterite kindergarten mother (teacher). "It helps the children and their mothers to realize that everyone should know his or her place." The status of the kindergartener is low. The child has plummeted from a relatively desirable position to the very lowest. Kindergarteners are considered willful and useless: "They can't do anything but memorize." The willfulness is somewhat threatening to a rigidly controlled people, and because the uselessness is no longer combined with complete dependency, it cannot be enjoyed by succoring caretakers. Verbal threats are used on children of this age for they are old enough to experience fear, yet not old enough to realize that the threats are empty. Most threats fall into one of two categories: those that teach that exclusion from the group is unpleasant; and those that teach that beyond the boundary lurks danger. Thus, a child may be warned that he will be locked in a hole under the house or given to a non-Hutterite visitor. If he opens a door, a bee in the closet will sting him, the dog in the (off-limits) barn will bite him, or a bear "outside" will eat him up. When it thunders, children are told that God is telling them they must be obedient.

Children pass the whole day in kindergarten, arriving before breakfast and, depending upon the convenience of the colony, leaving after an afternoon snack or after dinner. They learn to recite their prayers and hymns kneeling by the long benches, hands folded under their chins, the girls at one bench, boys at another. Rocking rhythmically, they recite very rapidly, the older ones doing so quite loudly. (This is the only occasion on which a kindergarten child may raise his voice.) No effort is made to explain the meaning of what is memorized. Children of this age are not permitted to touch any dangerous object. Until the age of six, they use only a spoon for eating and are not allowed to handle scissors, a knife, or a pencil. Several kindergarten children were strapped for playing with our five-year-old son's hammer and saw.

To the Hutterites, it is obvious that children have stubborn wills that must be broken; kindergarten helps teach the children not to be stubborn or willful. As one kindergarten mother explained when she swatted a child



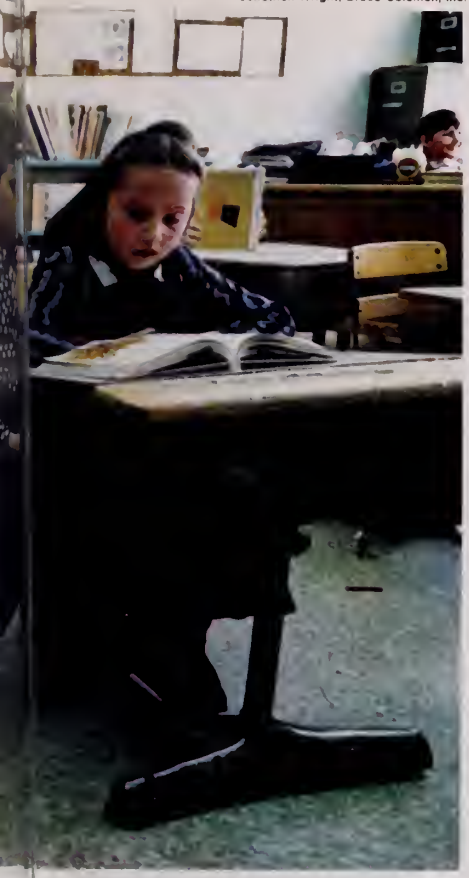
English school is where the child learns arithmetic, science, and the ability to read and write in the English language. The curriculum is similar to that taught in other rural schools.

who was licking his boot, "He's only three years old and still very young. He'll need many *britschen* before his will is broken." Children must obey the person in charge; they may not leave the kindergarten yard; they must share; they are not allowed to fight, quarrel, or hit; they are not to call one another names or use "bad words." In a *Gemeindordnungen* ("colony rules") of 1812, the members are reminded that "it is very sinful and rude" to call each other such insulting and contemptuous names as "pig" or "dirty dog." Yet the first Hutterite words our five-year-old used spontaneously were those for "you pig" and "you dirty dog."

The kindergarten mothers use encouragement, praise, and rewards with the children. The little boys are told to "eat up! eat up! so you can drive a Massey [tractor]." A child who has been helpful may have the privilege of going with the kindergarten mother to bring the food from the kitchen. A child who has behaved very well may be the first to be dismissed in the afternoon. A small child may be comforted with a little candy from the kindergarten mother's pocket, or a group of children may be promised a walk if they are good. Punishment includes scolding, switching, and threats. Some kindergarten mothers feel that a leather strap is too cruel for children and makes them tough without correcting them; a willow switch is better. The children are given only a couple of switches, and those older than four rarely cry. When a three-year-old was crying after being punished, one of the five-year-olds remarked, "We're already tough, we don't cry anymore, only Michael does." (Michael had just begun kindergarten.) The children are not punished in anger or vindictively. Their kindergarten mother, who as the name implies, regards them almost as her own children, is confident that she is helping the children grow into worthy Christians.

Kindergarten introduces children to their peer group and teaches them how to function in it. "They learn to obey, sing, sleep, memorize, and pray together." At an age when the child in North American society is developing individuality and a concept of self, the Hutterite child is placed in a setting that minimizes self-assertion and self-esteem and maximizes identity as a member of a group. Of all the age groups within the colony, the kindergarteners experience the most restricted, most regimented, and least varied program. Physically, the children spend virtually the whole day in one little building and small enclosed yard; they are cared for throughout the day by only one adult. There are no vacations during the school year except for half-day sessions on weekends and church holidays. The children learn to tolerate a restricted environment. They are rewarded for cooperative, docile, passive responses to correction or frustration. After entering kindergarten, the child's parents and the adult colony members no longer will accept the varied range of behavior permitted the child who is still considered to be a baby. The child must now be quiet around adults, even cry quietly. Visitors from other colonies do not greet kindergarten children or German-school children. Adults rarely play with them and no one wants them around. As a Hutterite mother said of her kindergarten-age son, "I'd certainly like Danny less if I had to see any more of him." The children can easily interpret these changes as rejections. But even though they have fallen from the "garden of Eden" status of house children, they have started the steady, rewarding ascent that leads to full, responsible membership in the colony.

Our kindergarten child, Daniel, vigorously protested his low status in the colony, did not identify with his Hutterite peer group, and saw no reward or purpose in the long climb to colony membership. He did not even want to drive a tractor, then or when he grew up. We protected him somewhat from full colony participation by not sending him to kindergarten regularly and by discouraging other adults from administering physical punishment, but we could do little to protect him from the older children. By Hutterite standards, he had not been sufficiently weaned from his mother and grandmother for he spent more time with the women in the family than is typical for Hutterite boys. The colony tried



Jonethen Wright, Bruce Colemen, Inc.

to integrate Daniel into the group, but his stubborn will had not been broken; he did not passively accept punishment at the hands of the older boys. He responded to teasing with anger; if an older boy called him a bad name, he responded in kind. The crueler the children were to him, the harder he fought back and the louder he yelled his objections—a response that is totally unexpected (and altogether unacceptable) in a Hutterite child of his age. The colonists considered him a woeful example of a child whose will was not broken at the proper time. His situation improved after his father arrived and he could go around the colony with the school-age boys who spent part of the time working with their fathers or brothers. Nonetheless, today he deplores the Hutterite way of life. Since we left the colony he has returned only for very short, uncomfortable visits. On the other hand, it may have been in the colony that he learned to minimize physical discomfort. He still ignores public pressure. He knows that if one is willing to pay the price, one can go against convention and probably survive; the group does not have to determine one's values or behavior.

"Just as iron tends to rust and as the soil will nourish weeds, unless . . . kept clean by continuous care, so have the children of man a strong inclination towards injustices, desires and lusts," wrote a Hutterite leader in 1652. And today the German-school teacher reminds his charges, "Good children are obedient, peace-loving, and God-fearing." Hutterites believe that children are inclined by nature to misbehave, but this belief does not mean that misbehavior should be tolerated. Rather, the responsibility for the children's behavior is placed on the adults, whose duty it is to watch over the children. Although these adults customarily use physical punishment to elicit good behavior, there are no battered or neglected children among the Hutterites. As children do

In German school, children learn to read German and write in Gothic German script. They must also memorize biblical passages, hymns, and innumerable episodes from Hutterite history.



Robert Weinreb

Robert Weinreb



Young Hutterite girls often create a secret world confined to a locked wooden chest. Here are found bits of the temporal world, such as cosmetics, cheap perfumes, sheet music, jewelry, and suntan lotion.

not know the difference between right and wrong, it is determined for them; they are taught "rules," not "ethics."

On his sixth birthday, the kindergarten child is taken by the kindergarten mother and handed over to the German-school teacher. Until his fifteenth birthday, the child will be under the care of this adult, eating all meals with the peer group, attending German and English school with them, and doing colony work assigned by the German teacher. The children are taught table manners and work roles. They learn to read German and to write in the Gothic German script. They learn to count, to be proficient with weights and measures, and they memorize innumerable biblical passages and hymns, as well as episodes from Hutterite history. German school is ungraded, and the children sit by age and sex. Material must be covered in a certain order and learned thoroughly, but children work at their own speed. Slow learners are praised as frequently as fast learners. Diligence, not aptitude, is demanded, and only a certain kind of questioning is considered acceptable. For instance, six-year-old Susanna received three slaps on her hand from the German teacher when she asked, "Why should I?" It would have been all right if she had asked "when" she should do a task, "how" she should do it, and "if" she should do it, but if told to do something, she must be obedient and not question why.

Children are not pushed to grow up either intellectually or morally. They are not taught self-discipline for it is not their prerogative to decide what is right; they are to do what they are told and those in authority will watch over them and punish and protect them. Similarly, children are not made to feel guilty; it is only natural for a child to sin and therefore it is not "his fault" that he misbehaves. Our school-age daughter angrily complained how unfair it was for us to expect "good" behavior when she was out of sight—none of the other children had to behave when they were not being watched.

Punishment by the German teacher is administered uniformly and fairly. Everyone receives the same punishment for the same offense. When several of the boys were late to German school because they were catching polywogs, the consensus was that the three straps they received were well worth the fun. They had known they would be late and what the punishment would be. The children were not lectured about their behavior, which Hutterites consider typical for boys, who naturally prefer polywogs to memorizing. The punishment was payment for the misbehavior, wiping the slate clean. Everyone knew that when the boys were older, they would be less interested in polywogs than in their colony responsibility. No one moralized, no one worried, no one was offended. A young child angry about being punished may tattle on other children, who will then be strapped as well, and they in turn may tell something on the first child, who will receive a second strapping. When the children are alone, they will pick on the original tattler, however, and so by the time the children are seven or eight, they rarely tell on one another. The peer group can punish more severely than adults, but it can also protect. When the children present a united front to authority, they can often avoid punishment.

The sisters in each family have their own playhouse and there are ever changing cliques determining who can play in which house. Social fickleness teaches the girls the unpleasantness of being excluded. The cliques quickly coalesce, however, to present a united front before the boys or the adults. The children's play reflects the community's de-emphasis of physical pain and complaining. They play games such as "whistle when it hurts" and invent spontaneous games of physical stress and daring. Their play is characteristically vigorous and often entails a great deal of roughhousing. Boys don't play with girls, except in group situations where conflict and competition between the sexes is the typical pattern.

When our house child, Caleb, returned to the colony as a schoolchild, he reported that German school was better than English school; the German teacher was kinder and more impartial than the English teacher. Caleb was more comfortable being swatted by the German teacher for playing with polywogs than being praised by the English teacher for a good recitation. He was comfortable and happy in the vigorous boys' groups, working hard and playing hard, knowing that breaking the rules meant punishment, but experiencing a kind of pack freedom where undue demands are not made on the growing child.

During our first summer in the colony, our schoolchild, Abigail, quickly internalized the rules of dress and conduct and instructed us accordingly. She identified closely with her peer group and participated fully in German school and Sunday school (except that she did not answer questions on the sermons), did all the colony work expected of children her age, and regularly waxed the floors for a woman

Jonathan Wright, Bruce Coleman, Inc



with a large family but no school-age daughter. Abigail learned to act shy in front of adults and to show no other emotion unless she was alone with the children, joining in their rough and boisterous play. Wholly submerged in colony life, she found it difficult to distance herself sufficiently to comment on her activities. However, the energy it took to "become" Hutterite was indicated by a request she made the only time our family was together outside the colony: "Drive slowly, it is so easy to breathe out here."

Perhaps because of her experience in the colony, today in almost every situation, Abigail picks up behavioral cues and notices how people are relating to one another. While she was living in the colony, Abigail did not want to differ from her peers. She passively accepted the "pruning" given all the "young, tender plants" as she learned the rituals that insure the smooth social functioning of the group. But because she was an outsider, she knew it was her choice to accept the pruning passively. It never occurred to her peers to exercise their choice, and she realized that they were unaware they had a choice. Having lived with people socialized not to recognize their individual freedom has made her sensitive to the lack of awareness of the freedom of choice exhibited by many individuals in our own culture. As she learned to see with Hutterite eyes, she realized how differently the world can be viewed and how from the same set of facts different conclusions can be drawn.

The most important birthday for a Hutterite is the fifteenth, for on that day the schoolchild becomes an adult, moving from the children's dining room to the adult dining room, from the children's group into the adult work force. Even the word used to identify the child changes: the *mandel*, "little man," becomes a *buah*, "boy"; the *dindla* becomes a *die-en*.

The adolescent years are a time for exploring boundaries. As long as their behavior during this period does not interfere with the young people's work, adults, remembering their own youth, accept it.

As this is a change involving a single individual, it is not celebrated by the colony. There is no party, no formal recognition, only orderly progress to the next step. The colony does not administer physical punishment to those older than fifteen, and so the other children teasingly tell their schoolmates that they will get a final whipping on their birthday. Instead the German teacher gives the fifteen-year-olds several religious books, discusses their future roles as adults, and emphasizes the importance of giving cheerful obedience to those who are

above them. Gradually, at the colony's convenience, new adults are given various gifts that reflect their altered status and are needed in their new roles. Both boys and girls are given a locked wooden chest in which to keep personal belongings. The boy receives new cloth for good suits and shirts, the girl material for dresses. Boys are handed work tools, which they are responsible for keeping in good working condition: a spade, a pitchfork, a hammer, a saw, and in some colonies, a spoon with the individual's name inscribed on it. The girls receive equipment that they will care for and use for colony work: a scrub pail, a paintbrush, a hoe, kitchen knives, a broom, knitting needles, and in some colonies, a rolling pin. For the next two years the young adult occupies an apprentice position before being assigned specific responsibilities, such as taking charge of a small tractor or doing the colony baking. These boys and girls constitute a mobile labor force that can be deployed throughout the colony as needed (in jobs considered suitable to their sex) and may be sent to other colonies to help during a time of need. The boys in this group do most of their colony's hard labor and enjoy the opportunity to demonstrate their strength and stamina.

Hutterite young people are in transition between childhood and adulthood. The colony recognizes both aspects of their identity. Physically, the young people are adults who can work responsibly with other adults. Religiously, they are children who must attend Sunday school and memorize and recite weekly verses. Emotionally, they vacillate. Appropriately, this period is sometimes called "the in-between years." Certain limited disregard of colony mores is expected, but moodiness or poor work performance is not tolerated. A good young person is "always obedient and never talks back."

The in-between years are a time for exploring the boundaries, for flirting with the world and learning about

Women are not involved in economic competition with the outside world. When ducks or geese are raised for colony use the women and children care for them; if they are a cash crop, men are in charge.



that which will later be rejected. Most young people occasionally watch TV, have photographs taken (Hutterites believe no one should make a graven image), and even own cheap cameras. From hidden transistor radios, they memorize popular songs. Quite a few of the boys own wristwatches and occasionally a boy will smoke secretly. To earn extra money, some boys trap during the winter and sell the furs or moonlight on neighboring farms. The girls have colored nail polish and may use it to paint their toenails, which are hidden under heavy, black-laced shoes. They have perfume and dime-store jewelry, fancy underwear and perhaps a pair of slacks—all of which are forbidden in the Hutterite community. The in-between years are a period of limited self-realization. A young man may even leave the colony for a few weeks, several months, or sometimes for a couple of years. In most cases, however, he is a "tourist" in the outside world who plans to return to marry and raise his family within the disciplined community.

There is a tendency, especially pronounced among the girls, to create a secret world during this time. As long as the make-believe does not in-



Robert Weinreb

Hutterite boys and girls make up a mobile labor force that is deployed throughout the colony as needed. The children perform tasks that are considered suitable to their age and sex.



terfere with their work and is not flaunted, adults tacitly accept it and, remembering their own youth, are indulgent. Sometimes the secret world is confined to a locked wooden chest; sometimes a corner of the attic is made into a personal microcosm. Here are stored bits of the temporal world—photographs, sheet music, suntan lotion, souvenirs. These artifacts represent, however meagerly, what the individual has the freedom to pursue or the freedom to renounce. They represent the world outside the colony, the self in its indulgent, vanity-pleasing aspects. As individuals mature and measure these trinkets and conceits against the full life around them, they generally find that the satisfactions received from active participation in the colony far outweigh those of self-indulgence. The Hutterite self-image requires colony identification.

During the last year or so of their status as young people, adolescents are expected to show by their proven works—in other words, by their daily behavior—that they can adhere to the rules of the colony. When they have displayed by their actions and know with their heart and mind that they cannot continue as irresponsible children, they willingly and humbly request baptism, so that they may become true members of the colony. The goal of the Hutterite system of child rearing is achieved.

Throughout the centuries, Hutterites have developed subtle ways to elicit social conformity. Not only our children were exposed to intensive socialization—so were we. The first step was our dressing Hutterite. Accepting the symbols of the culture reinforced acceptable behavior. My husband had his hair cut and his beard trimmed by a colony member, indicating not only that he was a married man but that he accepted the rules of the community. My mother and I wore long, dark dresses with high necks and long sleeves, and even when we were working in the ninety-degree temperature we kept our heads covered with a cap, which buttoned under the chin, and a closely woven, double-layered, black polka-dot scarf. The minister quoted to us, "By their fruits ye shall know them," which was interpreted to mean that by dressing correctly, we indicated our acceptance of our proper place in the universe. When my mother commented that she did not

After the age of three, the house child will slowly be weaned away from the nuclear family and start the steady ascent to full, responsible membership in the Hutterite colony.



see why we could not just wear the cap and take off the head scarf when the weather was so hot, she was told, "We can't expect to be comfortable here and there both." (If you are comfortable in this life, you should not expect to be comfortable in the hereafter.) When she found many of the small regulations pertaining to the lower status of women irksome, members of the colony implied that perhaps she was forgetful of them because of her advanced age. This was an effective means of soliciting conformity from a professionally competent child psychologist. With me, they implied that perhaps the colony work was too demanding. As status is closely tied to one's ability to work hard, long, and fast, I shaped up and conformed. Because by Hutterite standards my husband (an art historian) was low on skills, he worked with the older adolescent boys, as well as with the married men. When they felt he was not paying enough attention to his job, they would call out the number of strokes it took him to sink a nail.

The pressure on us to conform could not be resented because it grew out of the Hutterites' deep conviction of the rightness of their way of life and out of their acceptance of us. Patiently they instructed us and helped us. I learned to pluck live geese and was helped to create a spotless, flower-accented house to welcome my husband to the colony. We were reminded that being a nice person had nothing to do with where we would spend eternity; we were either "in the ark" or we were "not in the ark." The depth of their concern and generosity was evident when they offered to come any time to start a community with us. Although they do not go out as missionaries, the Hutterites were willing to send their centuries-old sermons with us. Twentieth-century individualists, we were privileged to share the details of everyday life with people who have all surrendered their own will and given themselves with singleness of heart to God and church. □



Craig Aurness



The Eskimo vs. the Walrus vs. the Government

Hunting walrus has traditionally provided Eskimos a means of subsistence. But should subsistence include color television, snowmobiles, and alcohol?

by Dan Strickland

The walrus-skin boat glided silently forward, its pliable bow pushing small chunks of ice to either side. The Eskimos were tense but ready, their eyes directed ahead, gloved hands checking rifles and cartridges.

"Take your cap off!" John whispered fiercely. "Walrus don't like red. They see that, they're gone."

I slid the wool cap from my head and stuffed it into a pocket, feeling immediately the gelid touch of the wind.

It was after midnight, but the Arctic sun hung stubbornly above the northern horizon. Its rays turned the pack ice to amber and seemed to gild the sea itself with a placid sheen. Across the disintegrating pack ice of this late spring night Little Diomede Island rose abruptly, a stark sentinel at the

Chlaus Lötscher

Hauled-out on an ice floe off Little Diomede Island, left, a herd of walrus takes its rest. John Iyapana, captain of the umiak, leads a crew of fellow Diomeders on one of their annual spring walrus hunts, below.





John W. Matthews

crossroads of the Bering and Chukchi seas off the coast of western Alaska.

John gripped my arm and directed me to one side of the umiak. "We'll approach in this way," he explained, illustrating with his hands. "Broadside, so everyone can shoot."

The umiak skirted a cake of ice and came suddenly on the walruses. Twenty massive bulls lay together on a large ice floe—grunting, bellowing, thrusting at each other with their heavy ivory tusks. Only one or two of the more wary animals glared at us as we drifted in closer and closer. We were scarcely fifteen yards away.

Edgar used the stilled motor as a rudder and the umiak turned slowly broadside to the walruses. John whispered a signal and firing erupted from the boat. There was a moment of confused hesitation before the enormous bulls began lumbering toward the edge of the ice. They slipped gracefully but ponderously into the sea, churning the water into a frothy turbulence.

Four bulls remained, motionless in death. The umiak's bow touched the ice and the crew leaped nimbly onto the floe. Long knives, carried in scabbards made from the skin of the *oogruk,* or bearded seal, were drawn and sharpened on whetstones. With a rapidity and skill born of years of experience the Eskimos laid the carcasses open and cut them into pieces that could be lifted easily, dragged to the skin boat, and heaved aboard. All the meat from the animals was salvaged, including the intestines, stomach, liver, and heart. Four sets of white ivory tusks were thrown in last, on top of the steaming meat. As we pulled away, little more than a red stain colored the ice.

The walrus-hunting season—heralded by the annual spring retreat of the ice to more northern waters—was only beginning for the Diomede people. The village was emerging from winter with a limited supply of fresh walrus meat. On these early hunting trips, great quantities of walrus and seal are brought back to the village by the crews. This meat is distributed among the people to fill their depleted caches. I wondered how much meat would be retrieved as the season progressed and greater numbers of walrus were harvested.

In 1977 and again in 1978, while working for the Alaska Department of Fish and Game, I visited many

Eskimos unload walrus meat and tusks from their umiaks, right. The bounty will be transported via snowmobile to the village on Little Diomede Island. A hunter, below, hacks the ivory tusks out of a walrus skull.





Fred Bruemmer

of the state's coastal and island villages to gather specimens from the walruses and seals harvested in the spring hunts. Hunting with the Diomede people gave me a vivid picture of the world in which they live, a world dramatically different from any I have known. In particular, I learned that the Eskimos have a perception of animals—indeed, of life itself—that is all their own.

In August 1728 Vitus Bering sailed through the strait that Capt. James Cook would name for him fifty years later. Bering christened two islands in the strait after Saint Diomede. Despite their proximity (less than three miles apart), Big and Little Diomede are split by the international dateline and mark the boundaries of two different worlds. Big Diomede belongs to the Soviet Union; Little Diomede, called Ignaluk by the inhabitants, is the northwesternmost extension of Alaska and has been home to a hardy group of Eskimos for centuries. Although many of these people came originally from Siberia and Big Diomede, visits between the islands have been curtailed since 1948.

The Little Diomederers are embroiled in a newer and more explosive issue than détente between governments. They are a hunting people. The waters of the Bering and Chukchi seas are treacherous, but abundantly rich in marine life. Walruses, seals, polar bears, whales, and sea birds have provided the Eskimos with skins and oil, meat and sinew, and with the inspiration for hauntingly beautiful legends, powerful dances, and traditional ivory carvings. But the Diomederers no longer subsist, as they once did, solely on the marine plants and animals of their islands and of the Bering and Chukchi seas. Twentieth-century technology has transformed their way of life and their relation to the natural world.

Contact with the outside world came when Russian and English explorers penetrated the northern seas in the 1700s. In the nineteenth century, Yankee whalers pushed north in quest of bowhead whales. The whaling ships sailed into the northern Bering Sea in late April to early May. Waiting for the ice to recede northward so they could pursue the bowheads into the Beaufort and Chukchi seas, the whalers traded with the natives for hunting implements, skin clothing, furs, and raw and carved ivory. This contact spurred a desire among the Eskimos for goods that were novel and delightful but always expensive. Coffee, tea, and sugar became as much staples for the Eskimos as they were for the whalers.

The coastal Eskimos could trade a wide variety of items, including baleen, fur, fish, ivory, and jade. The Diomederers, however, had mainly ivory. For centuries the strategic location of their island prompted these people to carve and trade, initially, for fish and furs from the mainland, then for glass beads and Asian trade goods via Siberia. Finally, the tempting novelties of the Yankee whalers were added to the flourishing trade.

The Diomederers became specialists at carving exquisite bracelets of ivory and baleen, lifelike walrus images, and representations of other animals and spirits that shaped their culture. Carving evolved over the decades. Ivory tusks drilled and etched into cribbage boards and such trinkets as swizzle sticks, gherkin forks, napkin rings, and statuettes of copulating polar bears joined the more traditional carvings of whales, walruses, and seals. Ivory became the basis of the Diomederers' economy.



Fred Bruemmer

In recent years the soaring inflation that has swept the lower forty-eight states has reached the Eskimo villages of Alaska, spurring an even greater effort among the Diomeders to acquire ivory. The cost of living in rural Alaska is exorbitant, but it pales beside the prices Diomeders must pay for what have become necessities of life. During the spring of 1979 gasoline cost $154 for a 55-gallon drum; by midsummer it rose to $206 a drum or $3.75 a gallon. Butter now sells for $2.55 per pound, and five pounds of sugar cost $2.90.

Diomede's high prices are largely the result of its inaccessability—it lies across twenty-four inhospitable miles of ocean from mainland Alaska. Groceries and mail arrive by skin boat during the summer. During the winter months supplies are brought by planes that land on the sea ice in front of the village, but these deliveries are at the mercy of capricious winds and shifting ice.

The remoteness of the island was poignantly impressed upon me one evening as we were hunting. A friend from Anchorage had joined our crew. He urged John to accompany him on a fall moose hunt in interior Alaska.

"When will this be?" John asked.

"We'll go in October," answered Joe.

Shaking his head, John sighed, "No, I have to be home in October. Otherwise I might not get in for the winter."

The brutally high cost of living has forced the Eskimos to rely heavily upon their one marketable commodity—ivory. On Little Diomede the yearly harvest of walrus has long since surpassed the number required to supply the meat needs of the village. After each spring's initial hunting trips, very little meat is retrieved from the animals killed. Other villages, such as Savoonga and Gambell on Saint Lawrence Island, have been slower to change, but now they too are turning inexorably toward increased walrus hunting for ivory rather than for food. The two ivory tusks carried by both male and female walruses, and the penis bone (baculum) of the male are retrieved, but the carcass is abandoned on the ice or pushed into the sea. Ivory carvings find a ready market in Nome or Anchorage. The art can be a profitable one. A young man from Diomede told me he could make $260 a day carving ivory, more if he really worked at it.

Hunting as a means of providing an income from ivory has touched off a blazing controversy in Alaska, one that has drawn national and international attention. Headless walrus carcasses washing up on Russian shores have placed Americans in an embarrassing light. The Soviet Union also harvests walrus annually, but the hunt is carried out under strict regulations and in a nonwasteful manner.

The killing of walrus for ivory alone stirs passionate emotions outside the Eskimo community, as well as within. The natives commonly either refuse to admit the practice exists or claim vehemently that this is bonafide subsistence. "We have hunted walrus for thousands of years," an elderly Eskimo recounted. "They have provided us with what we needed in the past, and they provide us with what we need now." What they need now, however, includes snowmobiles, television sets, slide viewers, generators, and outboard motors.

The softly spoken words of an old Eskimo emphasized the changes that have come to the villages. "When I was young," he said, "the village was quiet all the time and the whales and walrus would come very close to shore." He turned from the sea and glanced disdainfully at the roaring village generators. "Now we have snowmobiles, generators, six-wheelers . . . too much noise. The game never comes close anymore."

The changes are indeed great. Although skin boats are used by Diomeders and occasionally in the other villages, aluminum skiffs with powerful outboards have become the preferred craft. (The skiffs are faster than the skin boats, but they are more vulnerable to the crushing ice pack.) High-powered rifles have long since replaced the ivory lances and harpoons of earlier years. CB radios, binoculars, and compasses are acquisitions that have turned the Eskimo into a more effective hunter.

Yankee whalers certainly set a miserable example of restraint. When bowhead stocks declined in the 1870s, the whalers took walrus by the thousands. The ivory was chopped from the skull and the blubber rendered down for the valuable oil. In a ten-year period 100,000 walruses may have been harvested by whaling crews.

This intensive hunting sent the walrus population into a dramatic decline, from an estimated 200,000 animals to a low of 50,000 in the 1940s. The walrus herds were so decimated that it became uneconomical to hunt them and the industry died. Commercial walrus hunting was officially closed in 1941 with the passage of the Walrus Act, which prohibited the export of raw ivory from Alaska. The walrus population began to increase in the 1950s and today the herds in the Bering and Chukchi seas number between 140,000 and 200,000 animals. Walrus are "hauling out," or resting on shores and islands where they have not been seen for decades, indicating a rising population. Now the contention that the walrus population is dangerously high is voiced loudly and unanimously in most villages.

With the passage in December 1972 of the Marine Mammal Protection Act, the federal government took over marine mammal control from the state of Alaska. All hunting of marine mammals was abruptly stopped, bringing to an end the sport hunting of walrus allowed by the state. Eskimos, Indians, and Aleuts, however, were granted an exemption that allowed them to harvest these animals for subsistence purposes or for the creation of authentic articles of native handicraft. In January 1973, Alaska petitioned for re-

turn of the management of nine species of marine mammals important to coastal residents, both Eskimos and nonnatives. In April 1976 the federal government hesitantly yielded jurisdiction only over walrus, mandating that the annual harvest must not exceed 3,000 animals. If this number was exceeded, control of walrus hunting would revert to the federal government.

When the state of Alaska resumed management of walrus in 1976 it accepted a volatile situation. The number of animals killed in the spring hunt began to rise as more and more walrus were taken for their ivory. According to the Alaska Department of Fish and Game, Alaskan Eskimos took roughly 1,600 walrus in 1962; 2,300 in 1974; 2,600 in 1975; and nearly 3,000 in 1976.

As the number of walrus harvested approached the federal ceiling of 3,000, a limit was imposed and village quotas were set. Past dependence upon walrus was considered, as well as the availability of wage-earning jobs to meet the cash needs of the Eskimos. The villages of Gambell, Savoonga, and Little Diomede—historically the most dependent upon walrus—were initially accorded 450 walrus per year. The quota system was poorly received, difficult to enforce, and unpopular with both natives and those state representatives working in the villages. Hunting limits imposed by those who had ruthlessly depleted their seas of whales and walruses seemed ludicrous and high-handed to the Eskimos.

"You don't know what it is to be Eskimo," claimed one young man. "Out here hunting is our way of life. Carving ivory is our livelihood. We don't want welfare supporting us and we don't want to be forced from the villages.

"There are too many walrus now," he continued. "The Eskimos know this. There is no reason for these quotas. You do not understand how we live."

A biologist who has spent much time with the Eskimo people and is liked by them had this to say: "People speak of the noble, ideal Eskimo who wastes nothing. Unfortunately, that concept is fictitious, just as is the other voiced extreme that would have them all unscrupulous renegades. The truth lies in the middle. They are a people and a culture worthy of respect, but they are being bludgeoned by change. They are reacting as any of us would, taking each step in response to what they have and what they can do. Some are tougher than others. They hold up under the pressure while others break."

The swiftness with which changes have come to the Eskimos has generated problems long associated with the acculturation of one society into another. The Eskimos are not consciously turning from traditional ways. They are responding naturally to the choices offered them. The new variety of foods found in the stores is appealing, snowmobiles are faster and easier to handle than dog teams, and winter clothes and hunting gear are more readily bought than made in the painstakingly traditional fashion. Yet these changes are eroding traditions that have been a source of dignity and pride to the Eskimos.

In the past the Eskimos had no alternatives to facing the rigors of the Arctic environment. Hunting was a daily necessity that provided the Eskimo culture with a powerful, unifying theme. Legends portraying hunters and dances depicting courageous sea journeys were inspiring and supportive, fostering strong village ties. But modern technology and an ivory-based economy (which wastes valuable animal protein) have introduced competition among the hunters. Moreover, there are now alternatives to hunting. The Arctic continues to be a rugged home, however, and without the constant endeavor of hunting, the long winters can weigh heavily. Intriguing new life styles, conveyed vividly by weekly movies and taped television programs, impart a restlessness and dissatisfaction to the younger Eskimos. The legends and dances are still there, but their influence is weakening, yielding to that of bingo and basketball.

Rick Furness; Alaska Photo



The walrus hide that is being split may be used to build an umiak, or skin boat, which is still used on Little Diomede Island.

Unfortunately, some of the social transitions affecting the villages are more serious. Although most communities have voted themselves dry, liquor is easily obtained, and alcoholism, with all its associated problems, is a prevalent disease. Drug abuse is making inroads in the tiniest, most remote communities. Last year a youth died of an overdose of angel dust in the isolated village of Scammon Bay, north of the Kuskokwim River on Alaska's coast. The suicide rate is overwhelmingly high, a tragic index of the depression plaguing the Eskimos, especially the younger individuals.

John Iyapana was the captain of the crew I joined. Although the hunts were ofen long and arduous, John enlivened them with stories of past hunts and adventures. He and the others in the crew pointed out rocks and landmarks on the Russian and American mainlands, giving their Eskimo names and indicating where it was wise to watch for changing weather. Late one afternoon we were hunting close to Little Diomede. We had not seen any walrus or seal and decided to run in against the island and have *yo kuk* ("coffee break"). As we lay on the rocks waiting for the water to boil, John raised his hand toward the cliffs above us and said, "The old people say this is the best place on the island for boot liners. Come on, I'll show you how to gather the grass." We climbed the hillside and filled a large bag with the soft, dry grass.

"Bend this gently in a figure eight, without breaking it," John explained. "Then lay it on the bottom of your mukluks [skin boots]." He smiled, "It's warmer and softer than any wool sock."

The camaraderie and rapport between myself and the Eskimos was only occasionally subdued by reference to hunting walrus for their ivory. The hunters are somewhat defensive



NOW ALL THE BEST BOOKS ABOUT SCIENCE ARE IN ONE PLACE.

ANNOUNCING:

BOOK-OF-THE-MONTH CLUB

SCIENCE

51 books to choose from on these 4 pages.

BOOKS THAT ANSWER

Q: Are modern computers as smart as any living animal?

A: Today we have machines with the intelligence of the earwig, a tiny insect. This may not seem much, until you realize it took evolution millions of centuries to make the same leap. (See *The Micro Millennium.*)

Q: Can time speed up and slow down?

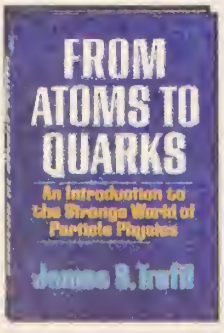
A: Yes, by the theory of relativity. Consider two twins. One leaves Earth in a spaceship, travels close to the speed of light, and returns. Although he's only a few weeks older he's astonished to find that Earth has aged hundreds of years. His twin brother, and everyone he knew, is long since gone. (See *Einstein's Universe.*)

Q: Most important brain functions are represented in both the right and left halves. But which vital function is only found on one side?

A: Speech. There are three speech areas in the brain, but in the vast majority of people they are all on the left side. (See *The Origin of Consciousness in the Breakdown of the Bicameral Mind.*)

Q: What seemingly unrelated invention was one of the main causes of the separation of classes in the Middle Ages?

A: The chimney. Before its invention, people of all classes had to mingle in the same room around an open fire. The chimney enabled heat to be distributed to different rooms, encouraging class separation. (See *Connections.*)



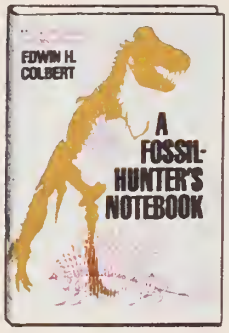
135 From Atoms to Quarks: An Introduction to the Strange World of Particle Physics. James S. Trefil. (Pub price $12.95)



123 Lucy: The Beginnings of Humankind. Donald Johanson and Maitland Edey. (Pub price $16.95)

121 The Complete Medical Guide (4th Edition). Benjamin F. Miller, M.D. Revised and updated by Lawrence Galton. (Pub price $19.95)

158 Time Warps. John Gribbin A fascinating discussion of time—its history in human thought, current scientific knowledge and the possibilities of such things as time travel, parallel universes and reincarnation. (Pub price $13.95)



132 A Fossil-Hunter's Notebook: My Life with Dinosaurs and Other Friends. Edwin H. Colbert. (Pub price $15.95)

116 Dolphins, Whales and Porpoises: An Encyclopedia of Sea Mammals. David J. Coffey (Pub price $17.95)

109 A Golden Thread: 2500 Years of Solar Architecture and Technology. Ken Butti and John Perlin. (Pub price $15.95)

131 Hans Bethe: Prophet of Energy. Jeremy Bernstein. (Pub price $12.95)

153 Wildlife of the Deserts Frederic H. Wagner (Pub price $18.95)



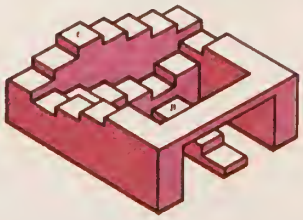
117 Prehistoric Avebury Aubrey Burl. Striking photographs and a fascinating text explore the mysteries and magic of "the most spectacular prehistoric monument in the British Isles." (Pub price $19.95)

106 Without Me You're Nothing: The Essential Guide to Home Computers. Frank Herbert with Max Barnard. (Pub price $12.95)

114 Unfinished Business: Pressure Points in the Lives of Women. Maggie Scarf. (Pub price $14.95)

110 The Lives of a Cell: Notes of a Biology Watcher. Lewis Thomas. (Pub price $8.95)

139 Connections. James Burke *Softcover.* (Pub price $10.95)



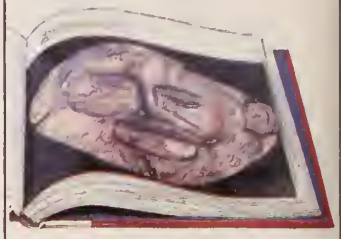
111 Mathematical Circus Martin Gardner. (Pub price $9.95)

100 Einstein's Universe. Nigel Calder. A fascinating and lucid explanation of the theories that changed man's understanding of time, space and motion. (Pub price $10)

128 The Micro Millennium Christopher Evans. A fascinating analysis of the computer revolution and the dramatic impact it will have on our lives. (Pub price $10.95)

125 Maps of the Mind. Charles Hampden-Turner. (Pub price $14.95)

157 Notebooks: B. F. Skinner. Edited and with an Introduction by Robert Epstein (Pub price $15.95)



101 Mysteries of the Past. Lionel Casson, Robert Claiborne, Brian Fagan and Walter Karp Editor: Joseph J. Thorndike, Jr. (Pub price $34.95)

124 The Origin of Consciousness in the Breakdown of the Bicameral Mind. Julian Jaynes (Pub price $12.95)

129 The Illustrated Origin of Species. Charles Darwin. Abridged and Introduced by Richard E. Leakey. (Pub price $25)

WONDERFUL QUESTIONS.



Painting by Don Dixon © Don Dixon

149 Science and the Supernatural. John Taylor
A distinguished physicist investigates psychic healing, telepathy, psychokinesis and other paranormal phenomena.
(Pub price $10.95)

134 Mathematics: The Loss of Certainty. Morris Kline
(Pub price $19.95)

144 The Gnostic Gospels
Elaine Pagels. (Pub price $10)

140 Earthly Pleasures: Tales from a Biologist's Garden.
Roger Swain. (Pub price $10)

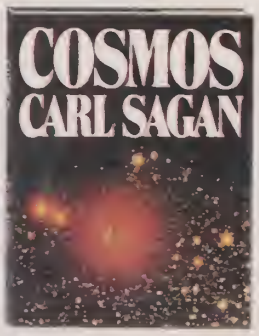
133 John Von Neumann and Norbert Weiner: From Mathematics to the Technologies of Life and Death. Steve J. Heims. A look at the careers of two of the 20th century's most extraordinary scientists. (Pub price $19.95)

126 Broca's Brain: Reflections on the Romance of Science.
Carl Sagan. (Pub price $12.95)

118 A Matter of Life: The Story of a Medical Breakthrough. Robert Edwards and Patrick Steptoe. The extraordinary behind-the-scenes story of the first baby conceived outside its mother's womb.
(Pub price $9.95)



© Giorgio Gulaco/ Bruce Coleman, Inc



103 Cosmos. Carl Sagan.
(Pub price $19.95)

113 The Arbor House Treasury of Modern Science Fiction
Compiled by Robert Silverberg and Martin H. Greenberg
(Pub price $19.95)



112 Favorite Audubon Birds of America. Introduction and Commentaries by Roger Tory Peterson. (Pub price $17.95)

142 The Expanding Circle: Ethics and Sociobiology. Peter Singer. A remarkable effort to synthesize the insights of both science and philosophy on the origins of ethics.
(Pub price $10.95)

Quasars at the edge of the universe, pouring out awesome amounts of energy.

Black holes twisting space and time like a pretzel—and gobbling down whole planets.

Here on Earth, the stunning adaptability of life: a desert animal that *swims* through sand the way an eel swims through water. And the ingeniousness of man: a new concept that may enable us to generate limitless electricity by duplicating the process that powers the sun.

And, in each of your cells—a substance called DNA, compressing into an invisibly tiny volume all the information needed to create *you*.

As someone living in an age of unparalleled discovery, you've undoubtedly been curious about things like these.

And you've probably noticed the explosion lately in books about science for people who are not scientists.

But how do you know which are the best? And where do you find them?

Let a whole new kind of book club do it for you. Book-of-the-Month Club/SCIENCE. A division of Book-of-the-Month Club.

If you've ever wanted the chance to really explore the wonders of modern science, this is the way. Because now you can be sure you're getting works that are understandable, lively and authoritative.

Book-of-the-Month Club/SCIENCE will lead you to books that indulge your sense of wonder to the fullest, sparkle with discovery, tantalize with new questions.

Books that can change your way of thinking. And the way you and your children live.

Here are books that will take you to the belly of a distant star. To the inside of an atom. To the love song of a bird.

Books that explore the greatest wonder of all—the human mind that is able to wonder.

It's all here. The vast worlds within you, around you, beyond you. The magic of the commonplace and realms where the commonplace is almost indescribably exotic. All joined together in a fine book club that identifies—and makes available to you—the best books about science. The science books *you* want to read.

We invite you to start by taking any 3 for $2 each.

BOOK-OF-THE-MONTH CLUB
SCIENCE
WHERE THE WONDER IS

CHOOSE ANY 3 BOOKS FOR $2 EACH.

You simply agree to buy 3 books within two years.

Facts about Membership

You receive the Book-of-the-Month Club/SCIENCE News® 15 times a year (about every 3½ weeks). Each issue reviews a *Main Selection* plus scores of Alternates. If you want the *Main Selection* do nothing. It will be shipped to you automatically. If you want one or more Alternate books—or no book at all—indicate your decision on the reply form always enclosed and return it by the date specified. *Return Privilege.* If the *News* is delayed and you receive the *Main Selection* without having had 10 days to notify us, you may return it for credit at our expense. *Cancellations:* Membership may be discontinued by either you or the Club, at any time after you have purchased 3 additional books.

Book-of-the-Month Club/SCIENCE
Camp Hill, Pennsylvania 17011 BS113-2X

Please enroll me as a member of Book-of-the-Month Club/SCIENCE and send me the 3 books I've listed below, billing me $6, plus shipping and handling charges, for all 3 books. I agree to buy 3 more books during the next two years. A shipping and handling charge is added to each shipment.

Indicate by number the 3 books you want ☐ ☐ ☐

Mr.
Mrs. 1-02
Miss
(Please print plainly)

Address Apt.

City

State Zip

CHOOSE ANY 3 BOOKS FOR $2 EACH.

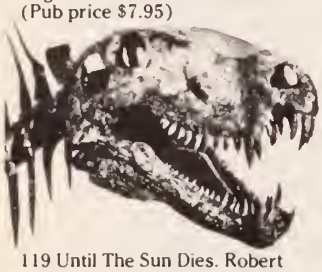
You simply agree to buy 3 books within two years.

105 Gödel, Escher, Bach: An Eternal Golden Braid. Douglas R. Hofstadter. Using Escher's drawings, Bach's fugues and Gödel's theorems as examples, a brilliant computer scientist explores man's seeming inability to understand the nature of his own thought processes. (Pub price $8.95) *Softcover.*

151 The Star Thrower. Loren Eiseley. Thirty-three poems and essays on the wonders of nature and the mysteries of man. (Pub price $12.50)

115 Astronomy With Binoculars James Muirden. (Pub price $8.95)

152 The Summer Stargazer: Astronomy for Absolute Beginners. Robert Claiborne (Pub price $7.95)



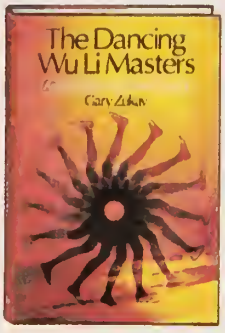
119 Until The Sun Dies. Robert Jastrow. A clear explanation of current scientific thought on the creation of the universe and the origins of life. (Pub price $8.95)

107 The Panda's Thumb: More Reflections in Natural History. Stephen Jay Gould. (Pub price $12.95)

136 The Amateur Archaeologist's Handbook. (Third Edition) Maurice Robbins with Mary B. Irving. (Pub price $11.95)

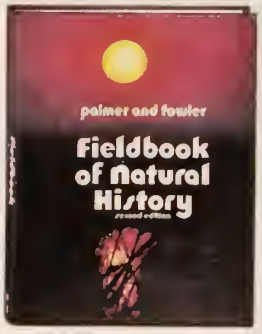


102 A Child Is Born. (Revised Edition). Photographs by Lennart Nilsson. Text by Mirjam Furuhjelm, M.D., Axel Ingelman-Sundberg, M.D., and Claes Wirsén, M.D., (Pub price $12.95)



120 The Dancing Wu Li Masters: An Overview of the New Physics. Gary Zukav. (Pub price $12.95)

154 Toward Distant Suns. T. A. Heppenheimer. By the author of *Colonies in Space*, a startling step-by-step scenario for the settlement of outer space. (Illustrations.) (Pub price $16.95)



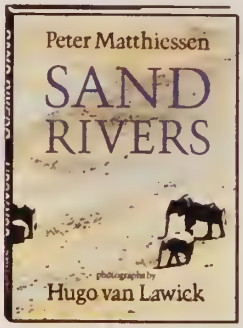
146 Fieldbook Of Natural History (Second Edition). E. Laurence Palmer. Revised by H. Seymour Fowler. (Pub price $19.95)

122 Tutankhamun: The Untold Story. Thomas Hoving (Pub price $12.95)

108 On Human Nature. Edward O. Wilson. How human evolution is interwoven with human behavior. By the author of *Sociobiology*. (Pub price $12.50)

137 Archosauria: A New Look at the Old Dinosaur. John C. McLoughlin. (Pub price $10.95)

147 On The Road With John James Audubon. Mary Durant and Michael Harwood. (Pub price $19.95)



130 Sand Rivers. Peter Matthiessen Photographs by Hugo van Lawick (Pub price $19.95)

150 Sex In History Reay Tannahill. (Pub price $17.95)

104 Anatomy Of An Illness. As Perceived by The Patient: Reflections on Healing and Regeneration. Norman Cousins. Introduction by René Dubos (Pub price $9.95)

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO. 2240 CAMP HILL, PA.

POSTAGE WILL BE PAID BY ADDRESSEE

BOOK-OF-THE-MONTH CLUB
SCIENCE

A Division of Book-of-the-Month Club, Inc.
Camp Hill, Pennsylvania 17011

BOOK-OF-THE-MONTH CLUB
SCIENCE
WHERE THE WONDER IS

Prices shown are publishers' U.S. prices. Outside the U.S., prices are generally somewhat higher.

about this activity, an attitude prevalent throughout the villages. It envelops the entire issue in a smothering shame that only serves to make more difficult the search for solutions. The hunting of walrus solely for ivory is an understandable, albeit lamentable, result of an expanding ivory market. If the guilt were to be lifted from the Eskimos, perhaps by a realization that their position has been shaped as much by our culture as by theirs, the managing agency and natives could work together more harmoniously.

Which agency will manage the walrus harvest is going to be a puzzling question. The state of Alaska returned control of walrus to the federal government on July 1, 1979. The federal restrictions placed upon state management were felt to be untenable and cumbersome by the state biologists involved. Just prior to this action the Alaska State Board of Game rescinded the walrus quotas, acknowledging that the walrus herds may be undergoing population stress. On a biological basis, then, the state gave tacit approval for an increased harvest of animals.

Under federal control the Eskimos are again being allowed unlimited subsistence hunting. Walrus will no longer be subjected to sport hunting by nonnatives, which the state had allowed shortly after it resumed management in 1976. The number of walrus harvested by sport hunters in 1976 was about 150 out of the yearly take of 3,000. The Eskimos are divided over the issue of sport hunting because guiding associated with these hunts brought substantial money into the Eskimo community.

Management by the federal government creates an additional dilemma. Under the Marine Mammal Protection Act the native exemption is granted for subsistence and handicraft use only. The state recognized that walrus hunting is closer to a commercial endeavor and was seeking markets for the surplus products. Walrus meat is strong and rich but quite palatable. Certainly in a world starving for protein this meat could be utilized. The thick hides of the bull walrus, although heavy, cumbersome, and difficult to retrieve, are used in industry on buffering wheels. Walrus stomachs can be scraped, dried, and made into the traditional skin drum of the Eskimos. This spring, coastal villages were buying prepared stomachs for $75 a piece from the Diomede hunters. This search for commercial outlets may be impeded, depending upon the most recent interpretation of the Marine Mammal Protection Act. Although the wording of the act is vague regarding what constitutes waste of an animal, the native exemption is obviously aimed at subsistence use and not commercial enterprise. Programs such as the installation of large community freezers in some villages to hold excess walrus meat are suddenly left on unsteady ground. Although these freezers would hold additional meat for the Eskimos' use, they are meant primarily to facilitate the commercial sale of walrus meat. Restaurants in Nome and Anchorage have expressed interest, and the Japanese have made inquiries.

Chris Arend Alaska Photo



Diomeder carvers find a ready market for walrus-ivory figures, such as this puffin. The income from such carvings is supplemented by the sale of ivory swizzle sticks and pickle forks to mainland tourists.

It is difficult to foresee what walrus management will be like under the federal government. If the present Eskimo hunting practices are interpreted as wasteful, a herculean effort will be required to curtail their harvest. The ivory trade could be outlawed, but a flourishing black market already exists, as evidenced by the illegal traffic in polar bear skins traced to Alaskan Eskimo villages. And the Eskimos would not be easily dissuaded from hunting. They feel no one has the right to take that from them. Biological evidence further complicates the picture: The walrus population may be at a level where it could absorb the Eskimos' harvest without serious impact.

In the clear light of an Arctic evening I watched a drama unfold on the ice, one that summed up the complexity and intricacy of implementing effective walrus management. Our crew had fired into a walrus pod. Most of the animals plunged into the sea, leaving behind three dead companions and a young, wounded bull, with tusks protruding a scant six inches, which struggled valiantly to reach the water. Normally, hunters quickly dispatch a wounded walrus, and I looked at our crew, expecting a rapid reaction to the bull left alive on the ice. But no one moved.

As the Eskimos continued to watch the walrus intently, I realized that they were hoping the animal would reach the water. If it was not retrieved, the walrus would not be included in the village quota.

I looked back to the young walrus and thought sadly what a strange ritual was being performed. Because limits had been imposed on the number of animals harvested, this walrus might have been wasted simply because his ivory was small. And the hunters, a people who have lived from the animals of the sea for centuries, have been placed in a situation where they permit this to happen.

The walrus writhed a few more times. At last, one of the hunters raised his rifle and fired. The animal lay still. We moved in to butcher the carcasses, an embarrassed quietness pervading the air. It was an impressive example of well-intentioned regulations having unforeseen effects when actually applied.

When the cold winds begin to sweep down from the Beaufort and Chukchi seas this fall, the walrus herds will funnel through Bering Strait and move into their wintering grounds farther south. Spring will come again to the Bering Sea Eskimo villages, and with it, the walrus hunting that is so much a part of these people and their lives. Progress can be made toward a more efficient harvest, but the steps toward that end should be carefully weighed and closely scrutinized. The Eskimo way of life, whether it be called traditional or twentieth-century mainstream, is at stake. □

Acid Rain and Gray Snow

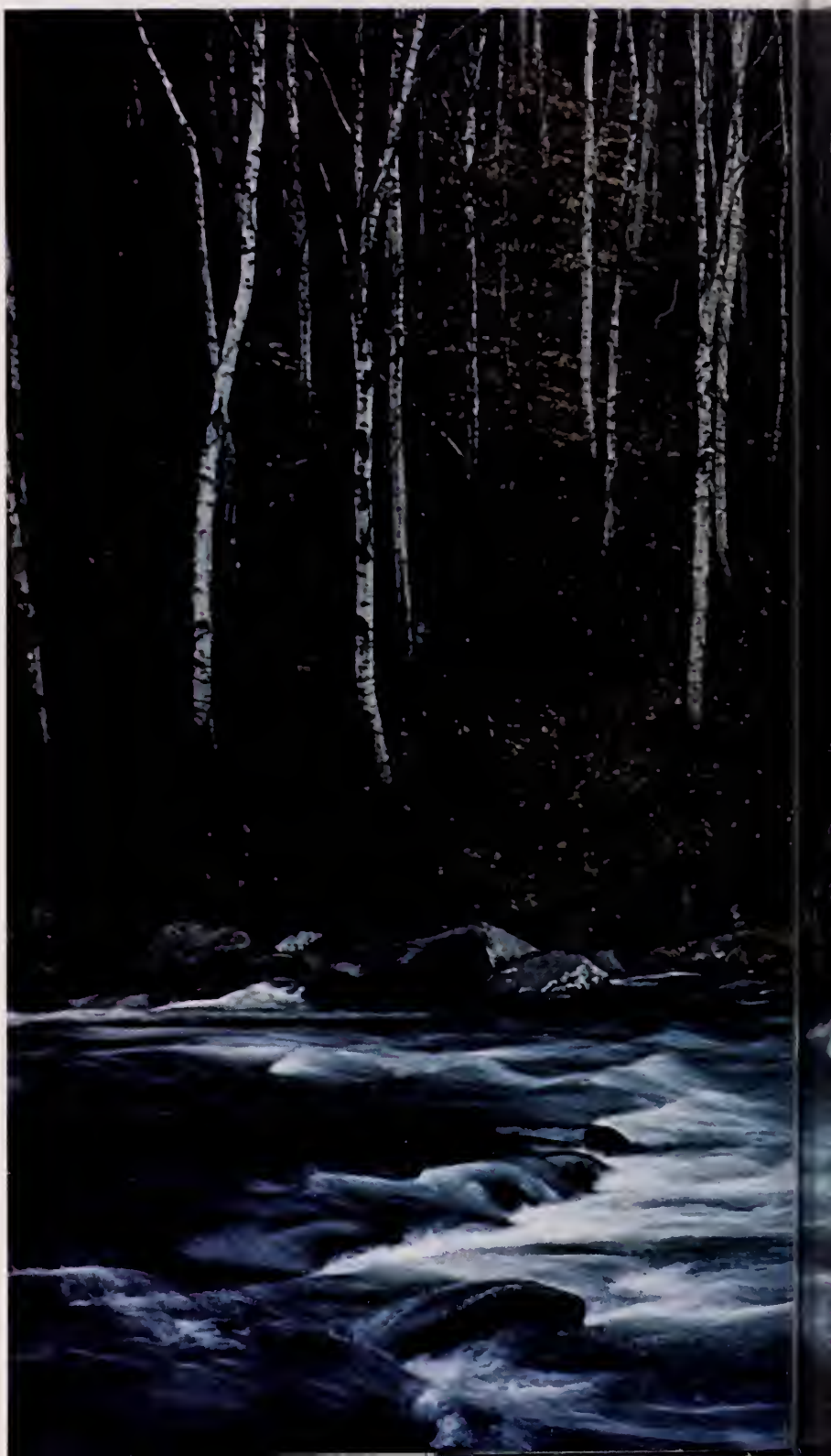
In many parts of the world, rain is no longer gentle and snow no longer white

by George R. Hendrey

Mountain lakes and streams, long regarded as symbols of purity, are becoming increasingly contaminated by atmospheric pollution. Rain and snow that have become loaded with toxic chemicals, mainly acids, have been falling over nearly all of the eastern United States, southeastern Canada, northern Europe, and southern Scandinavia. More recently, California, Colorado, and Washington State have been added to the list of regions known to be receiving acidic precipitation. In many places, the rain is so polluted that numerous species of freshwater animals would be killed if they were exposed directly to water having its average chemistry.

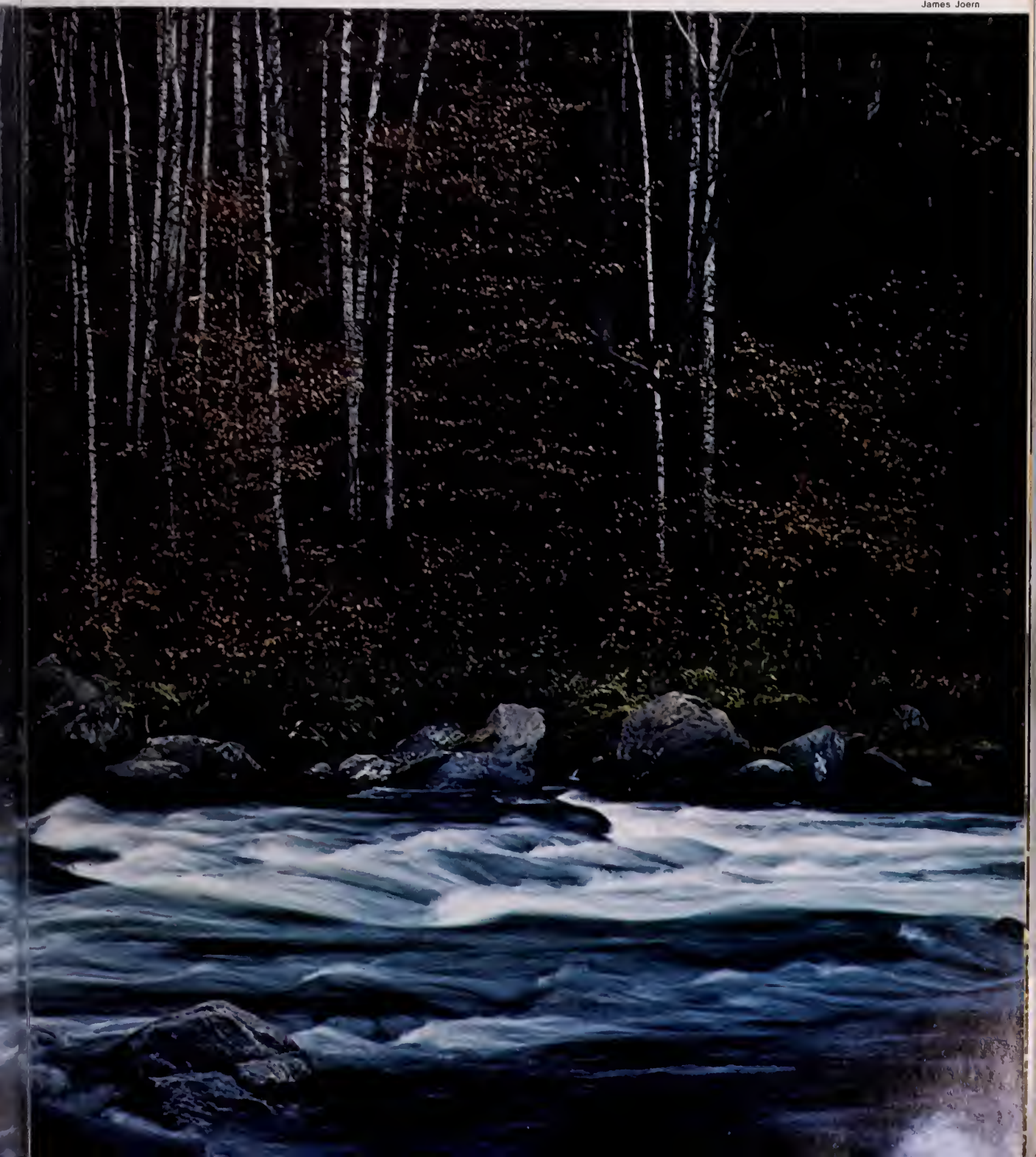
The pollution is caused primarily by the combustion of large amounts of fossil fuels—coal, oil, and gas. Oxides of sulfur and nitrogen created in the combustion process are released into the atmosphere, where they react with oxygen, water, and other substances in the air to form sulfuric acid and nitric acid. These two pollutants are what cause the rain to be so acidic.

In 1940, about 22 million tons of sulfur oxides and about 6.7 million tons of nitrogen oxides were spewed into the atmosphere from American homes, factories, and power plants. By 1976 these emissions had risen to 32 million tons of sulfur oxides, a 45 percent increase, and 25 million tons of nitrogen oxides, a 273 percent increase. Large increases in power plant emissions of sulfur oxides during this period were partly offset by decreased



Streams in certain mountainous areas, including the Adirondacks, are particularly sensitive to acidification. The drainage basins of such streams typically have relatively little soil cover and a minimum of minerals capable of neutralizing the acidity of precipitation.

James Joern



emissions from other industries and from homes and businesses that shifted from coal to oil or gas. The total amount of sulfur oxides released into the atmosphere therefore did not increase as dramatically as the amount of nitrogen oxides. The increased nitrogen oxide emissions were primarily from motor vehicles, factories, and power plants, in that order.

Ironically, the installation during this time of extremely tall smokestacks at some power plants often helped to transform a local problem into a regional one. The tall stacks emit large amounts of pollutants high into the air where they are carried long distances by the wind, thereby gaining more time in which to react chemically to form sulfuric and nitric acids.

There is little evidence so far that airborne acidity has injured crops and forests, but the evidence of environmental damage in freshwater lakes and streams in severely affected regions is unmistakable. Some lakes are more susceptible to acid precipitation than others. Among the factors that determine the extent to which a lake may become acidified are the amounts of acid or acid-forming materials that are deposited, the sensitivity of the soil and bedrock to acidification, and the topography of the watershed.

When scientists speak of a lake being acid, they are referring specifically to the concentration of ionized hydrogen in the water. In chemical shorthand, this form of hydrogen is specified as H^+. The presence of H^+ is what gives solutions their acidity.

For the sake of convenience, the concentration of H^+ is often expressed in terms of the pH scale. The scale is logarithmic, so that a rise or fall of one pH unit represents a tenfold change. Thus, pH6 is ten times more acidic than pH7, and pH5 is a hundred times more acidic than pH7. In unpolluted, clear, natural waters, the pH level is rarely below 6.

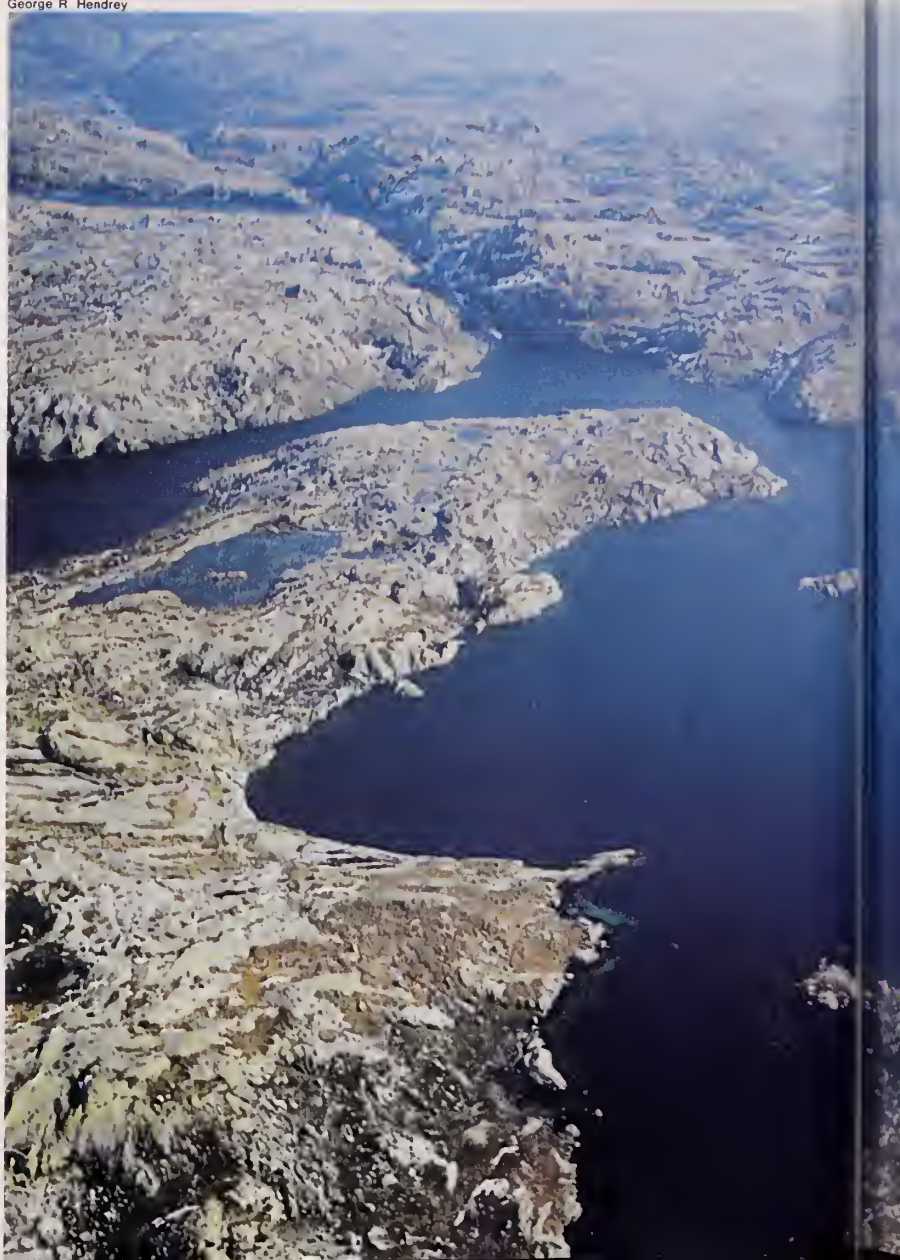
In neutral water (with a pH of 7), the H^+ concentration is very low, about one-tenth part of H^+ to a billion parts of water, or 0.1 parts per billion (ppb). Pure water, which is in equilibrium with the atmosphere, will have carbon dioxide dissolved in it, making a slightly acidic solution of pH5.6, or 2.5 ppb. This is often referred to as the pH of "unpolluted" rain. Many lakes that have been acidified by acid rain now have concentrations of 30 parts of H^+ per billion parts of water—300 times the concentration of acid in neutral water. We know that the concentration of H^+ in rain in the northeastern United States is sometimes as high as 3,000 ppb, which is 30,000 times as high as neutral water and more than 1,000 times more acidic than "unpolluted" rain.

The ability of water to neutralize H^+ is called its buffer capacity, and it is determined, for the most part, by the alkalinity of the water. Alkalinity, in turn, comes primarily from the weathering of minerals in the watershed. Limestone and other, similar minerals are the most important substances that provide alkalinity and, hence, buffering capacity.

As acidification proceeds, the alkalinity is removed in the form of carbon dioxide and lost from the water. This diminishes the water's acid-neutralizing capacity. When acids deposited from the atmosphere percolate through a watershed, aluminum is also dissolved from soil and rocks. Hydrogen ions are exchanged for aluminum ions in the minerals of soil and rocks. By decreasing the amount of H^+, this process may decrease acidity, but aluminum can be a threat to fish. Aluminum concentrations, which are usually well below 0.1 parts per million (ppm) in lakes and streams, are greatly elevated through the exchange of H^+ in regions with very acidic precipitation. Acidified waters in the Adirondacks, for example, have concentrations of 0.2 to 1 ppm of aluminum. At 0.2 ppm, aluminum is quite toxic to fish.

Most of the regions in which lakes and streams are acidified have thin soils and relatively large amounts of

George R. Hendrey



exposed bedrock. In these areas the chemical characteristics of the bedrock determine the fate of the acids deposited from the atmosphere. Limestone terrain has a nearly infinite ability to buffer H^+, but hard crystalline rocks such as granites contain no minerals that could contribute alkalinity, are slow to dissolve, and therefore have little ability to neutralize acids.

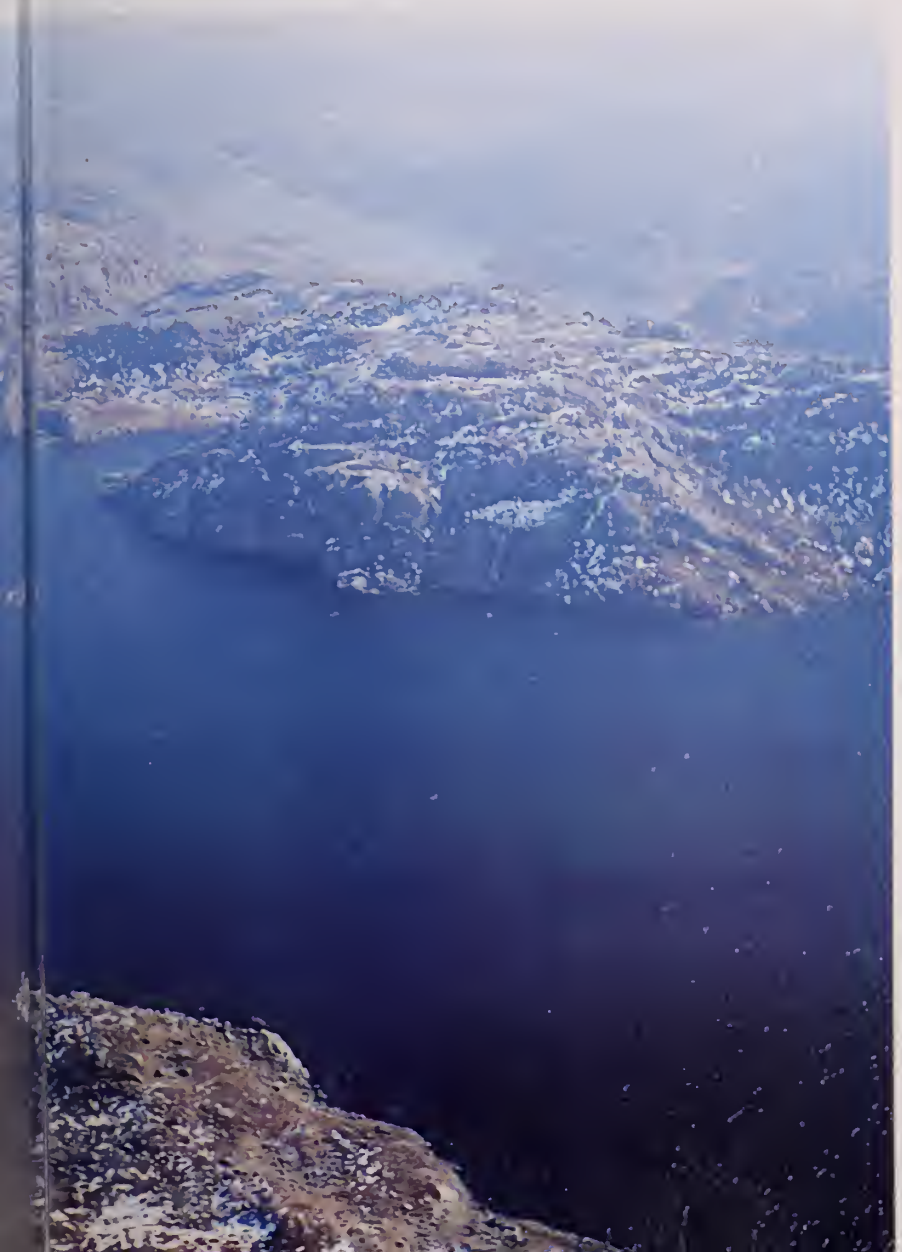
The freshwater regions of North America where acidification is most severe are the Canadian Shield and the Adirondack Massif. In less sensitive regions the bedrock is more extensively covered by soil, derived either from the local bedrock by means of erosion or transported into the area by water, winds, glaciers, or landslides. A transported soil, in contrast to local soil, may be quite different from the bedrock under it, and deep soils as well as shallow ones can be transported. Nevertheless, whatever the source, the deeper the soil, the greater the possibility of contact with water passing through it. Therefore, even soils with little buffering capacity can, if they are deep enough, neutralize acidic precipitation.

The topography of a region has an important influence on the susceptibility of its lakes and streams to acidification. Mountainous areas, for instance, are likely to have shallower soils and more exposed bedrock than lowlands. Many mountain streams have little water and sometimes dry up. Close to the top of their watershed, these streams get relatively little ground water and, since they swell rapidly during small rainstorms, are in many cases vulnerable to the chemical effects of rain. Studies conducted last year in the Shenandoah National Forest by James Galloway of the University of Virginia show this to be true for some streams in the Blue Ridge Mountains of the southeastern United States. Before these studies, this region was not known to have been affected by acidic precipitation.

Another way in which topography influences lake and stream acidification is by increasing the amount of precipitation they receive. When bodies of air moving across lowlands encounter a mountainous region they are forced to rise. As they rise, they encounter diminishing atmospheric pressures, and the air expands to occupy a larger volume with the same mass. The heat contained in the rising air parcel is also distributed throughout a larger volume, so that the temperature of the air decreases. This cooling process is what causes clouds to form and rain to fall more frequently over the mountains than over lowlands. The first rain that falls after a body of cooled air has passed through a mountainous region tends to remove more pollutants than subsequent rainfalls do, thereby causing the mountains nearest the source of the acidic air pollution to receive more acid than neighboring areas.

In 1979 a computerized inventory of water chemistry data from the eastern United States was set up at Brookhaven National Laboratory on Long Island. Known by the acronym ACID (for Acidification Chemistry Information Database), this inventory reveals that waters with low alkalinities (that is, less than 100 ppb) are found in many areas of the eastern United States. A large number of such headwater streams have probably become at least temporarily acidified by rain or snow that is strongly acidic.

Abundant snow is a feature common to the geographical regions most heavily affected by acidification. But much of the snow is no longer pure. Like the rain, it carries a burden of pollutants released by humans into the atmosphere. In fact, falling snow is



The lakes and streams of southern Norway began to lose their fish populations decades ago. There are now thousands of lakes in this region from which fish have been completely eliminated.



Lenny Newman, Brookhaven National Laboratory

The installation of tall smokestacks at power plants, beginning in the 1950s, allowed emitted sulfur oxides to spread more widely before being deposited, providing time for greater portions to be converted into sulfuric acid. Such airborne acid can fall as acid rain hundreds of miles from the source of pollution.

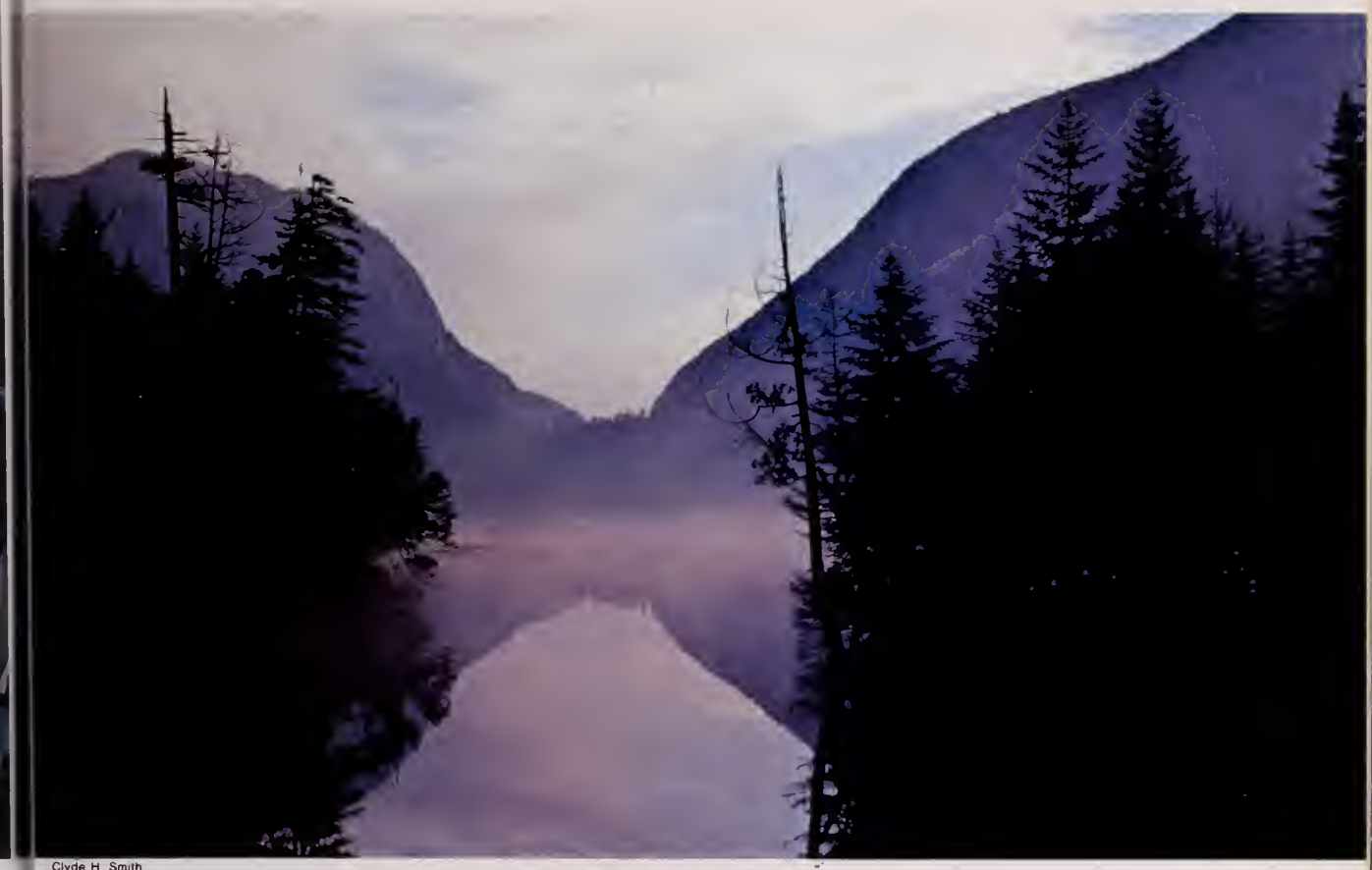
sometimes a dirty gray. And not just in industrial towns, but in areas such as south-central Norway, many hundreds of miles from the sources of the pollutants. Snow cores taken from that region of Norway contain gray bands corresponding to specific snowstorms that carried fly ash and other contaminants east and northward from the industrial regions of Great Britain and the rest of Europe. I have not yet seen this kind of banding in the snows of the Adirondack Mountains, probably because of the relatively stringent rules concerning airborne emissions of particulate pollutants in the United States. Some American snow, however, like the snow in Norway, is contaminated with acids.

When rainwater freezes to form sleet, the ice crystals created in the process tend to exclude molecules of all substances other than water. A water droplet containing sulfuric acid will thus become a small clump of ice covered with the droplet's total amount of acid. The acid on the outside of the tiny clump is accordingly in a more concentrated form. Furthermore, ice and snow crystals serve as attachment sites for sulfur and nitrogen oxides, where the adhering oxides can react with other pollutants and water. When the sleet or snow falls to the ground, the pollutants stay bound to the outside of the crystals. As the snow pack ages, a slight melting and recrystallization take place, increasing the size of the ice particles. Since pollutants continue to be excluded from the crystals, they become even more concentrated on the outside of the ice particles. If the partial melting occurs above a layer of solid ice in the snow pack or on a lake, one or more bands of concentrated pollutants may be formed within the snow pack.

As soon as enough melting takes place to allow water to move freely through the snow, the first meltwater will remove a large portion of all of the soluble pollutants. Researchers at the Norwegian Institute for Water Research have shown that this mechanism typically removes 50 to 80 percent of the pollutants in the first 30 percent of the meltwater. The sudden release of acids and other pollutants from snow that has collected for weeks or months can cause drastic acidification in lakes and streams. An example of this process can be found in Panther Lake in the western Adirondack Mountains of New York State. The lake usually has a pH of slightly above 7, almost neutral. But when the snow melted in the spring of 1979, the pH dropped to about 5, an increase in ionized hydrogen of about a hundredfold.

The cause and effect relationship between acid rain and the disappearance of fish was first suggested by a Norwegian fisheries inspector in 1959. It was publicized in Norway in 1966 and has subsequently been well documented. Concern about acid rain was not felt anywhere until Scandinavian scientists began to notice that many lakes and streams in southern Norway and on the west coast of Sweden were losing their populations of fish. The decline in the salmon catch in major rivers of southern Norway is most striking. The Tovdal River salmon catch began an unprecedented decline in the late 1920s. Periodic fish kills, which may have been caused by drops in the springtime levels of pH, possibly combined with simultaneous increases in the concentration of aluminum, gradually reduced the stock of Atlantic salmon in the river (although other factors such as overfishing might also have played a role and cannot be completely disregarded). The scientific documentation for this period is poor, since few pH measurements in streams were made. We do know, however, that in the past two decades the entire Tovdal River, with pH values in the range of 4.6 to 5.2 in 1975, has become so acidic that throughout most of the year Atlantic salmon cannot survive in its waters. These low pH values are in marked contrast to those in Norwegian rivers beyond the reach of airborne acid.

In 1975, Carl Schofield, a fisheries biologist at Cornell University, conducted a survey of 217 Adirondack



Clyde H Smith

Lake Colden in the Adirondacks, once highly prized by trout fisherman, is now so acidic that fish cannot survive in its waters.

lakes at elevations above 2,000 feet. Fifty-one percent of these lakes were found to be acidified to a pH of 5 or less, and 90 percent of those found acidified had no fish. Some of those lakes supported fish forty years ago. Studies made in the 1970s in Canada also show that lakes in certain areas, ranging from southwest Ontario eastward to Nova Scotia, are losing all their species of fish.

Levels of pH and alkalinity taken from the 1930s through the 1950s are now considered unreliable because the methods then used for analysis put chemicals into the water to produce a color indicator of acidity and alkalinity, and that process altered the variables being measured. Electronic methods of measurement have replaced the old techniques, but the unreliability of the old data has caused some people to question whether or not acidification has occurred at all. They suggest that perhaps the lakes were always acidified. The biological data, however, are an independent and reliable indicator of acidification. Fish have disappeared from numerous lakes and streams that are reported, on the basis of measured chemical change, to have become acidified. Fish have also disappeared from hundreds of bodies of waters for which no chemical data from an earlier period are available. These waters are now too acidic and their aluminum concentrations too high for fish to survive. When fish are stocked in such lakes, they die. It's hard to argue with a dead fish.

The futility of stocking such waters is illustrated by the history of Lake Colden, a small lake at an elevation of almost 3,000 feet in the heart of the Adirondack Mountains. Described as a fisherman's paradise, Colden was one of the best trout-fishing lakes in the area but the annual catch declined from the 1950s through the 1960s. Efforts to stock the lake in the 1960s met with failure; the new fish died quickly. The last fish disappeared in 1970.

The food supply available to fish in lakes is greatly altered as acidification proceeds. In those lakes having a pH from 5 to 6—a range in which the ionized hydrogen level has a marginally negative effect on trout—there are significant changes in the availability of different species of zooplankton (microscopic organisms suspended in the water), insects, other aquatic invertebrates, and plants, all of which serve as food for some fish. The number of zooplankton species declines with decreasing pH levels as was demonstrated in my work involving large-scale surveys of Norwegian lakes. Scientists at the University of Bergen, in Norway, evaluated the biomass, or weight, of bottom-dwelling invertebrates in three lakes with a pH range of 4.3 to 4.7 and five lakes with a range of 5.8 to 6.2 and found less food available to fish in the more acidic lakes. Although the availability of fish food organisms has been found to decrease in some acidified lakes, the effects of these changes on fish life have not been investigated.

Some of the invertebrates that are the normal elements of a fish diet have a low tolerance for acid and cannot be found below a pH level of 6. Such is the case with the tadpole

shrimp (*Lepidurus arcticus*). Ordinarily, this organism undergoes a rapid series of molts as it progresses from the egg to maturity. My studies show that a pH of 6, which is only slightly acidic, delays the normal rates of progression through this series of distinct life stages and more and more of the animals die before becoming adult. As the pH level decreases, interference with the progression of life stages and premature death both increase. Another common invertebrate, the freshwater scud gammarus (*Gammarus lacustris*), is also absent from waters with a pH level below 6, and my research has shown that even gammarus adults cannot tolerate a decrease in pH much below the 6 level. Immature stages of this scud would probably be even more sensitive to high acidity.

Animal life of all kinds in lakes and streams, from fish down to the smallest invertebrates, depends upon energy from food, which is derived either from plants growing in the water or from organic litter such as leaves and twigs transported by the wind or the flow of streams. In streams and small lakes or ponds, plant litter is the most important food source for animal life. Ecologists have shown, however, that bacteria and fungi are very important in making these sources of food available to animals, and many invertebrates obtain more energy from eating these microdecomposers than from eating the leaves or other detritus with which the microbes are associated. Decreasing this microbial activity may therefore have profound effects throughout the food web of a stream or lake.

Investigators working in the 1970s observed abnormal accumulations of organic litter in Swedish lakes. The suspected cause was inhibited decomposition due to low pH levels. Several other concurrent studies in North America and Scandinavia, including experiments in stream acidification and lake neutralization, indicate that microbial decomposition is retarded by acidification.

Small algae that live suspended in the water of a lake are called phytoplankton. By means of photosynthesis, these plants reproduce themselves, creating new organic material in the water, a process known as primary production. This process is one of the basic steps in providing energy from food for the animals of a lake. We have already seen that the number of species of phytoplankton is reduced by acidification, but we do not know whether acidification also alters the process of phytoplankton production.

The production of phytoplankton is regulated by the availability of both sunlight and nutrients. In lakes that are sensitive to acidification, the critical nutrient is phosphorus, a key substance regulating plant growth. When the effects of acidification on phytoplankton production in different lakes are compared, it is difficult to tell whether the differences are due to the acid itself, to the presence of other material, such as aluminum, that is increased due to the acid, or to the low availability of nutrients. For most lakes that are susceptible to acidification, the susceptibility arises from their low concentrations of essential nutrients and of various chemicals, such as calcium, magnesium, and bicarbonate. Acidification appears to retard the exchange of nutrients between sediments, decomposing litter, and the water, however, and so in the presence of acidification, nutrients are probably even less readily available. The acidification of watersheds also releases aluminum into the ground water, and aluminum can bind to phosphorus, preventing it from moving through soils. By this process, the supply of phosphorus in streams and lakes may possibly be reduced in acidified watersheds, which would reduce phytoplankton growth. If acidification does reduce phytoplankton production, then part of the foundation of animal life and, consequently, the supply of food for fish, would be reduced.

A side effect of lake acidification is to make lake water clearer. This may result from the acid reducing the brownish color of natural humus materials in the water, from a reduction in the density of algae in the water, or from some combination of these two factors. Algal density would be reduced if the availability of phosphorus was decreased, but whether that decrease actually takes place is not yet known.

Large aquatic plants also seem to be altered by acidification. In some acidified lakes, particularly those studied in Sweden, abnormal and very dense growths of sphagnum moss are found. In Lake Colden, where pH values declined from about 5.5 in the mid-1950s to 4.7 in the summer of 1979, sphagnum, not reported in a botanical survey conducted in the 1930s, is now abundant on the lake bottom. Another development seen in the Swedish lakes, Lake Colden, and many other acidified lakes, is the extensive growth of long, threadlike algae.

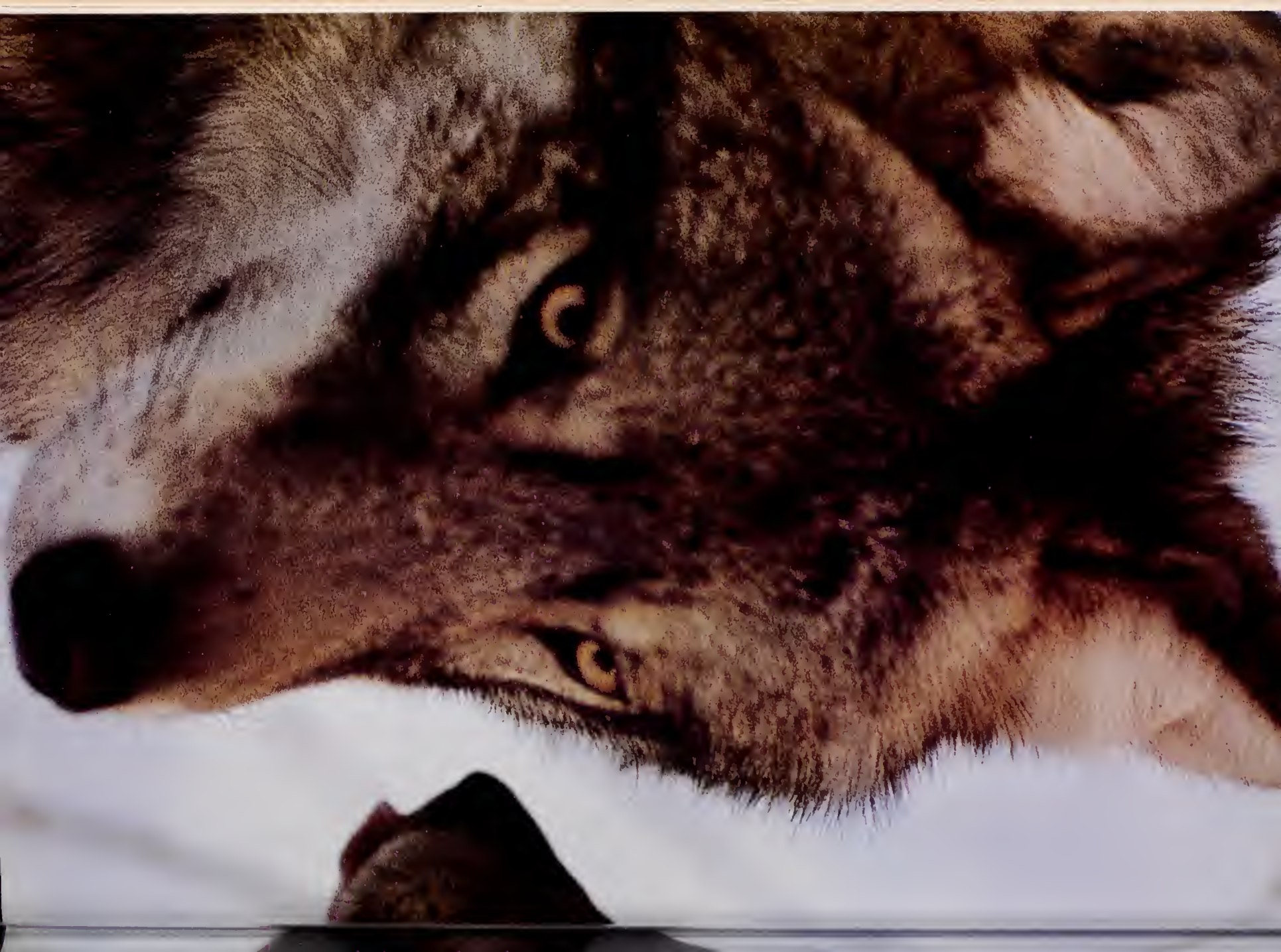
Both the sphagnum and the algae form mats that become a tight barrier, sealing off the bottom sediments from the overlying water. Since normal microbial decomposition seems to be retarded by acidification, the underside of these mats may constitute a rich source of organic materials. Low rates of microbial activity eventually consume all the oxygen in this zone, and a new oxygen-free environment develops. Anaerobic bacteria (those that live without oxygen) can thrive there, and although they are slower and less efficient in decomposing material than aerobic bacteria (those that require oxygen), they too decompose the dead plant matter, producing the gases carbon dioxide, methane, hydrogen sulfide, and some more complicated and smelly organic acids and sulfur compounds as their waste products. These wastes erupt from below the algal mat in great bubbles. I suspect that this is the cause of the garbage-dump-like odor that wafts over the surface of some acidified Adirondack lakes during the warmest parts of the year.

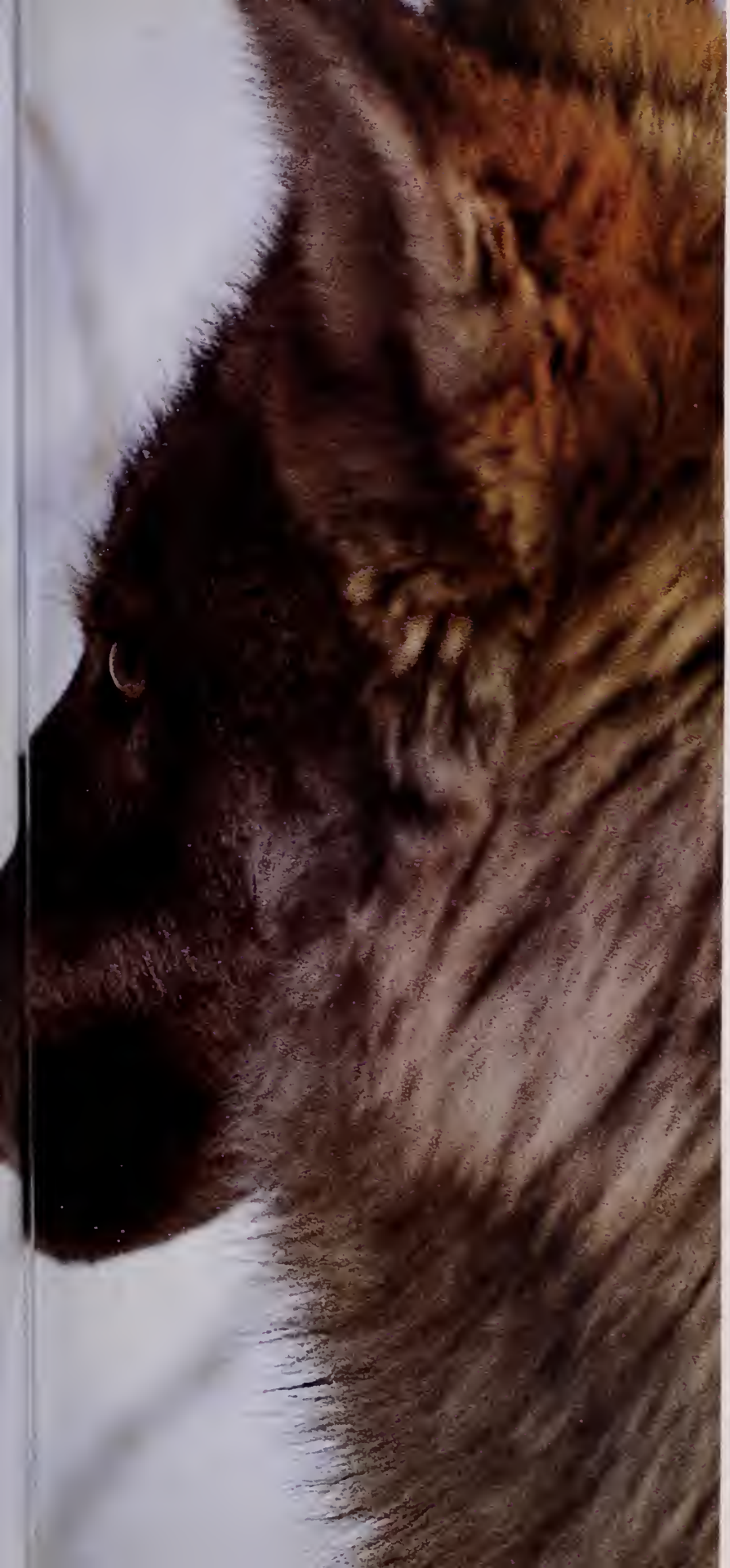
In summary, lakes and streams sensitive to acidification are located in regions where the bedrock and overlying soils are deficient in easily weathered minerals and thus cannot provide much buffering capacity to surface waters. Mountainous regions are particularly susceptible to acidification. Many lakes and streams in North America from Florida to Newfoundland have already been acidified. In extreme cases, the biological consequences include the complete elimination of fish and many other species of animals and plants. At intermediate pH levels, the relationships among organisms are likely to be changed in ways that are not yet known but that may exacerbate the problems of freshwater fish life. □

Plant litter in lakes, such as these autumn leaves, is an important source of food for animal life. If the microbial activity that makes this food available to animals is inhibited by acidification, the lake's entire food web may be affected.

Bruce D. Thoma







Italian Wolves

A dog howls in the middle of the night as a lone wolf passes through a sleeping village high in the mountains of the Abruzzi. Otherwise unnoticed, the wolf searches for the food scraps that help it eke out a precarious existence

by Erik Zimen

In 1972, when a compilation was made of Italy's endangered plants and animals, the wolf was at the top of the list. Wolves were not legally protected and could be shot, poisoned, or trapped by anyone, anywhere, at any time. But a campaign conducted by the World Wildlife Fund (WWF), brought a surprisingly swift reaction from the Italian government: the wolf was made a protected species for two years. The effort to save the wolf suffered from a great shortage of information, however. No one knew how many of the animals there were or where they were living, and so it was agreed that the WWF would conduct an inquiry into the distribution of wolves in Italy.

When the WWF offered me the job of conducting the inquiry, I did not hesitate for long. The project would allow me to supplement my investigations of captive wolves with observations of wolves living in freedom. Also, I had often criticized biologists for making scientific studies of different kinds of animals without bothering about the question of their being threatened with extinction. There will be plenty of time for academic inquiries when the urgent practical problem of protecting such species has been solved. So I accepted on the condition that the WWF provide me with an Italian counterpart, namely, my colleague Luigi Boitani.

Luigi and I agreed that attempting to count the wolves in Italy would be a hopeless task. The area that would

Excerpted from *The Wolf: A Species in Danger*, by Erik Zimen. Translated from the German by Eric Mosbacher. © Delacorte Press/New York, 1980

Erik Zimen

have to be investigated was far too big. In the Alps wolves had been exterminated by the end of the nineteenth century, but no one knew where they still survived in the Apennines, which stretch all the way from south of the Po Valley to the southern tip of Calabria. Even if we confined ourselves to the higher altitudes, that would still mean an area of about 27,000 square miles. So we decided that Luigi should first visit all the areas where wolves might still be expected to exist and gain an impression of their numbers and distribution by questioning local people.

He soon found that most of the information he was given was useless. Too many prejudices and lively imaginations led in most cases to the wildest exaggerations. Finally, he concentrated on questioning people who had direct contact with wolves, such as foresters, road workers, hunters, and shepherds, although much of what they told him was contradictory.

The only certainty seemed to be that for several years the wolf had been extinct in both the northernmost and southernmost parts of the Apennines; it had also been exterminated in Sicily. Elsewhere, its distribution seemed to be restricted to about ten enclaves in the higher parts of the Apennines. Luigi felt that because of the density of human settlement and the many roads, highways, and railway lines in the lower areas, there could be no connection between the wolves in these various enclaves. As the estimated number of wolves in some of these areas was very small, it looked as if their extinction there was only a matter of time.

In the only distribution area outside the higher areas of the Apennines, the Tolfa, just north of Rome, the wolves' days seemed to be numbered too. We were surprised that they had survived at all. The Tolfa is an extensive but sparsely inhabited farm region in which good refuge areas for wolves seemed to be completely lacking. That wolves did exist there, however, was demonstrated by the discovery within the city limits of Rome of a young wolf that had been run over by an automobile.

I was eager to begin an actual count. Luigi suggested the Abruzzi, an area in the central portion of the Apennines easily accessible from Rome. On the basis of his inquiries, he estimated that within a 650-square-mile-area in the Abruzzi, there were about twenty-five wolves. The Abruzzi is bounded by the Gran Sasso in the north, Monte Velino and Monte Sirente in the west, the Maiella massif in the east, and the Parco Nazionale d'Abruzzo in the south. There is a strong maritime influence on the climate and, at higher altitudes, an annual precipitation of more than fifty inches. There is precipitation about 110 days each year, and in winter there is generally permanent snow cover above the 3,000-foot level.

While the northern part of the Abruzzi is to a large extent unwooded, thick beech forests cover the steep mountain slopes from 3,600 to 6,000 feet in the central and southern regions. In some places in the national park area, primeval pine forests still survive. Above the forested area there is extensive open pastureland that finally gives way to a bare, rocky high-mountain zone. Below 3,600 feet the common beech gives way to hornbeam and oak. Here, too, there is extensive pastureland, and in the valleys corn and wheat are cultivated. Still lower, at altitudes below 2,000 feet, grapes, as well as other fruits, vegetables, and wheat are grown.

At altitudes of more than 2,500 feet, sheep are kept. The local flocks are small, seldom exceeding two hundred sheep and a few goats. At night the sheep are held in stone sheds in the villages, and when there is no snow on the ground they are driven out to pasture close to the villages. In summer some are taken higher up into the mountains, where they spend the night in fenced pens. In addition to



these local flocks, big flocks from the plain are driven into the mountains where they graze from the middle of June to the end of October. These larger flocks can consist of several thousand animals, and they, too, are guarded by shepherds and dogs in the daytime and kept in pens at night. Thus there is no grazing of the kind practiced, say, in Scotland or the western United States, where sheep are left unguarded day and night, grazing over wide areas. In the past fifty years there has been a steady decline in the number of sheep in the region and a slight increase in the number of cattle. In the summer the cattle graze freely, like sheep in Scotland.

The human inhabitants of the Abruzzi live chiefly in the lower-lying regions, in villages, small towns, and a few larger towns. The population density of the entire province is 202 persons per square mile. At higher altitudes small villages lie in the foothills of the mountain ranges, at heights of up to 3,600 feet. Here there is an average of 75 persons to a square mile. Until the middle of this century there was a high rate of emigration from these areas, and some villages were completely abandoned. But in recent years the development of tourism has led to a movement in the opposite direction, and many emigrants now return from Britain, the United States, and Australia. The big skiing resorts are Roccaraso and Pescasseroli in the national park.

In the southern part of the Abruzzi there is a small population of about 60 to 100 bears, the last in the Apennines. The chamois has been exterminated, apart from about 500 animals in the national park. Roe and red deer were also exterminated, and attempts to reintroduce them in the national park began in 1972. Wild boar similarly had almost completely disappeared, but a slow natural increase in their numbers has now begun. As far as the wolf was concerned, Luigi had reports of them only from the more densely wooded areas of the Maiella and the national park area, and it was there that we began our fieldwork.

In view of the wolves' great shyness and their secretive way of living, there was no way of studying them other than with the aid of telemetry. Two and a half years of following Abruzzi wolves equipped with radio transmitters showed us a way of life markedly different from that of their counterparts in the wild in North America. North American wolves, which generally travel in packs, cover great distances in their territory, and sleep in a different place every day. Only during the cub-rearing period in summer are their movements star shaped, so to speak, to and from the place where the cubs are. In the Abruzzi, however, this star-shaped activity continues throughout the year. Every wolf (or small pack) had a few places in its territory to which it returned day after day, sometimes for weeks on end. These "traditional resting areas," as we called them, were in areas that were to a large extent inaccessible to human beings, on steep slopes covered with thick beech forest. The distance to the nearest village was not necessarily great, but the places were such that humans rarely went to them.

In winter the wolves kept to lower altitudes, and in summer they went higher up the mountain. We also noticed that in many areas, they remained at higher altitudes on Sundays than they did on weekdays. Many of the lower-lying areas where cars could go were overrun on fine Sundays by



Marka, Photo Reporters

Shepherds lose most of their sheep to wolves during storms and periods of heavy mist conditions or when the sheep are confined in fenced pens. Solitary kills are the most common, although occasional large kills have been reported.



crowds of picnicking Italians, so it was sensible on the wolves' part to keep out of the way. Sometimes we actually had the impression that they withdrew higher up the mountainside early on Sunday mornings, as if they knew the picnickers' invasion was imminent, but that could have been chance.

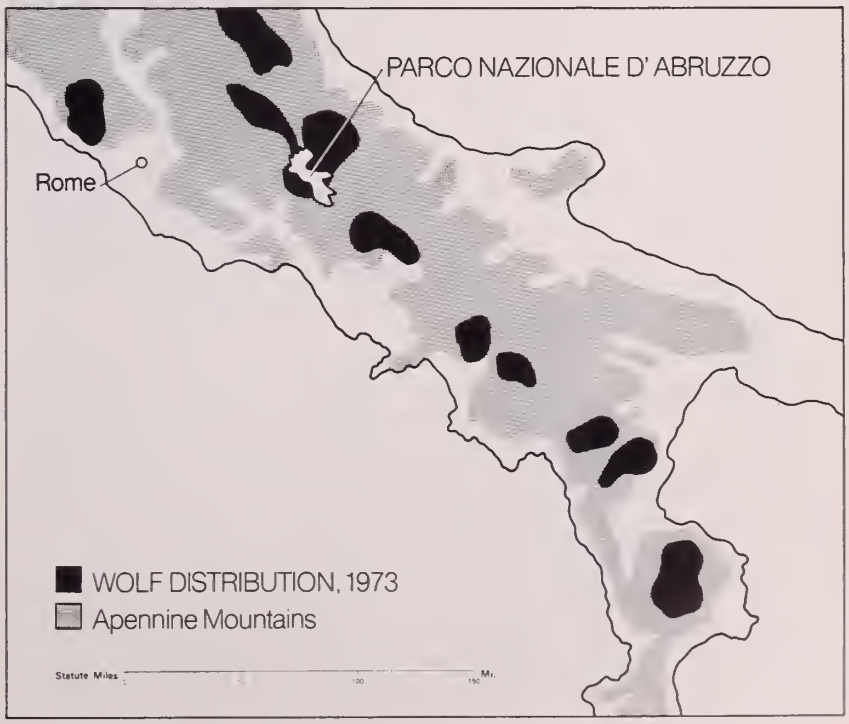
When darkness fell the wolves emerged from their refuge areas and set out on roamings that took them from one place where food might possibly be found to another. First, they might go to a refuse pit, then a village, then a sheep shed, then another refuse pit. In the morning they withdrew again, often to the place where they had spent the previous day. This was the time of day when we were most likely to see them. In the evening they nearly always waited until it was dark before coming down, but in the morning they often stayed below until the first peasants appeared in the fields. Thus they adapted themselves to a large extent to the rhythm of human activity, which generally lags a few hours behind the state of the sun.

Sometimes the wolves would be late in returning to the mountains from areas of human habitation. In that case some wolves would stay in a hiding place all day long and not move on until darkness fell. For example, wolf 1/2 (the first male we captured, marked with a "1" in the left ear and a "2" in the right ear) occasionally spent the day in a small woods below a village, not a hundred yards from the nearest house. On the other hand, wolf 9/10, a female in the Maiella region, made great detours in order to return to her daytime resting site, the steep rocky slopes at the foot of the Maiella above Santa Eufemia.

The wolves seemed to have an excellent knowledge of human habits. Although food was to be found only in the neighborhood of humans, the wolves avoided contact with human beings as much as possible. In summer, they hardly ever used tarred roads but made good use of tracks and paths. In winter, roads that had been cleared of snow were their favorite routes. Open, unwooded country where the wolves were likely to come across human beings was avoided in the daytime but used at night or very early in the morning. This applied particularly to the summer months, when human activity in such areas was much greater than in winter.

I had an interesting experience with wolf 5/6, a young female in the national park. She was definitely a "refuse-pit wolf," and her favorite daytime resting place was at a steep spot above the Pescasseroli refuse dump. One summer evening in 1974 I followed her from the refuse pit to the ruins of a big hotel above Pescasseroli. The village lay beneath us. I took care not to approach too closely in the car. In the village everything was quiet, except that music was still coming from Pepe's bar. The she-wolf remained above among the ruins. Only when the light went out at Pepe's did she come down into the village. I could not believe my eyes, but she went right on through the sleeping village. While dogs howled frantically all over the place, she crossed the village square and went right down the main street and past the national park headquarters before making off in a southerly direction.

In spite of such behavior, few people in the Abruzzi have ever seen a wolf. Wolves are occasionally surprised by headlights on the main road, but for the most part they are only seen sporadically, by game wardens, forest police, and, of course, shepherds. Even we, who tracked them so closely, saw them relatively rarely. My wife, Dagmar, had been in the Abruzzi for a long time before she saw her first wild wolf, between the tennis courts and the empty swimming pool in the middle of Campo di Giove. In this instance we had tracked 7/8, an old she-wolf, right into the village. When the signal suddenly became very loud, I switched on our big spotlight and soon caught her in its beam. As was quite normal, she took no notice of the light. Headlights obviously did not mean danger to wolves, since we watched them for hours at refuse dumps in the beam of our headlights without their seeming to take any notice. At Campo di Giove the she-wolf 7/8 was looking for something to eat. Down in the valley a passenger train slowly worked its way up the mountain from Cansano, and the illuminated carriages clattered noisily by. The she-wolf was directly below by the rails, but she did not even look up at the passing train. Dagmar saw her second wolf at the Caramanico refuse pit. In this case a fox and a cat were present in addition to the wolf, and as one might expect, the cat kept its distance from the fox and the fox kept its distance from the wolf. The next morning we found that the animals had been eating a big load of slaugh-



Red deer from Yugoslavia and Bavaria were released into the Parco Nazionale d'Abruzzo in the 1970s. The aim is to wean the wolves from their dependence on humans for food by reintroducing their natural prey.

ano Cappelli, World Wildlife Fund

Scattered individuals and small packs, restricted to a few enclaves high in the Abruzzi Mountains, are all that remain of the Italian wolf population. They survive on a diet of domestic sheep and human refuse.



Giuliano Cappelli, World Wildlife Fund

terhouse refuse that had been dumped there.

Thus the wolf seems to have adapted itself admirably to man—its only enemy and at the same time its source of food. It is active when humans—creatures that orient themselves chiefly by sight—are either visually restricted or asleep. This applies not only to nighttime or the season of deep snow but also to daytime periods when visibility is restricted by mist. There is often thick mist on the Passo San Leonardo, and in summer, when sheep graze in the area, the mist brings the wolves. When mist appears, the local shepherds immediately take their small flocks down into the valley and, if visibility is no better there, put them back in their sheds. But shepherds from other regions, who often have no experience with wolves and have big flocks and inexperienced dogs in the bargain, do not always appreciate the danger and fail to collect their many sheep and drive them down to the valley in good time.

It was in such a situation that the first wholesale killing of sheep during our work in the area took place in the summer of 1974. Luigi and I were informed that in the national park 300 sheep had been slaughtered by wolves in the Maiella area. After calling the *carabinieri* station at Santa Eufemia for confirmation, we went immediately to the spot. Unfortunately, we were too late. Because of the danger of an epidemic, 150 dead sheep had already been buried with the aid of a bulldozer. A shepherd who had been present told us that late on the previous afternoon there had been a sudden thunderstorm, accompanied by a thick mist. Two flocks, each of 500 sheep, had been grazing around the half-deserted village of Roccacaramanico on the slopes of Monte Morrone, and they were at once driven down toward the valley. Just as the shepherds were driving the sheep into the pens, five to seven wolves had suddenly appeared. The dogs had run away and the wolves had scattered the sheep.

When the storm was over the shepherds had counted 150 dead sheep in an area of about 250 acres. And another 150, belonging to one of the biggest sheep owners in the Abruzzi, had disappeared. The official veterinarian and the forest police who investigated the incident confirmed this story, so we had no reason to disbelieve it, although the 150 vanished sheep struck us as rather strange. Moreover, the owner of the sheep was a businessman with a doubtful reputation.

At the insistence of the WWF, the Abruzzi authorities had decided that year for the first time to pay compensation to sheep owners for damage caused by wolves, as it was obvious to us that wolves should not be protected at the expense of private individuals. Consequently, the owner of the missing 150 sheep was entitled to full compensation for his losses. Since the sheep in question were said to be particularly valuable animals imported from France, the amount involved was not small.

Two days later news arrived that forty of the vanished sheep had been found. This time we were not too late. The animals, all dead, were lying close to the roadside below the Passo San Leonardo, and under the direction of the forest authorities, some shepherds, and the owner of the sheep, a bulldozer was digging a large hole. We were just in time to stop the burial and have a look at the dead animals. The fraud was evident immediately. The sheep allegedly killed by wolves each had a nice clean slit in the area of the throat, obviously made, not by teeth, but with a knife. Also the gastrointestinal tract, which putrefies rapidly, had been removed from each animal. Some of the animals had certainly been gnawed at, but they had all been killed by humans. Dogs, wolves, and foxes had subsequently been able to eat their fill.

We passed on these observations to the forest police, who were astonished. The owner of the sheep tried to explain to them that it was all the work of wolves, but the whole thing was too obvious, and a new report was drawn up. The sheep owner, who had greeted our arrival in a rather unfriendly fashion, now seemed transformed. A long conversation followed in which I used very hard words indeed. Luigi asked to speak to the owner alone, and he turned out to be far more adept than I. After many hours of discussion, and a good dinner at the hotel up on the pass, the truth came to light. It was finally agreed that for our part we would not make a fuss about the matter, while the sheep owner would not put out poison for wolves. Moreover, he agreed to support our efforts to secure the establishment of a large protected area in the Maiella region; his endorsement promised to be of great importance in view of his political influence.

What had happened? The story of the storm and the raid by the wolves was correct. The wolves had killed some sheep but not 150, and they had not driven away another 150. To increase their compensation the shepherds had killed more of the animals and claimed they had been killed by the wolves. The shepherds had not had these sheep buried but had sold

them, with the sheep that had allegedly disappeared, on the black market to local butchers. One of the butchers had suddenly grown nervous, however, when he saw a number of forest police in the pass. In his anxiety not to be found out, he had dumped his "hot" merchandise, and later the stinking sheep had been scattered about to make it look as if they had been killed by wolves.

This was certainly not the only attempted fraud in this first year of compensation. Altogether nearly 38 million lire (about $70,000) was paid out in the Abruzzi in 1974. We estimated that at least half the reported kills were either outright inventions or the work, not of wolves, but dogs. Similarly, Franco Tassi of the national park estimated that the real damage done was from 20 to 30 percent of what was claimed. In following years the conditions for paying out compensation were made stricter at our suggestion. Only killings actually identified as such would qualify, shepherds had to have a sufficient number of dogs, and one shepherd could not be in charge of more than a hundred sheep. This last requirement could easily be met by local shepherds, but because it was hard on those who came with their big flocks in summer, it was not strictly enforced. As a result the forest administration began building big, secure pens in the mountains that neither wolf nor bear could enter. Overall, compensation payments greatly diminished.

While sheep are constantly watched, cows and horses graze freely, and on several occasions I saw wolves making their way through herds of cattle or horses without these animals taking any notice and without the wolves showing any sign of wanting to attack them. To the wolves, which are relatively small in the Abruzzi and run only alone or in small packs, cattle and horses are simply too big. It was only rarely that we could be sure that a dead calf or foal had been killed by a wolf. In most cases the young animal had been separated from its mother. With horses, the mother was always hobbled. This is a normal practice that makes the horse easier to catch, but it is a handicap against wolves, and many foals have paid for it with their life.

By far the largest number of sheep killed while we were working in the area were solitary animals. At night wolves crept up to the fenced pens and



If you'd like to know more about charcoal mellowing, drop us a line here at the distillery

IT'S EASIER TO UNDERSTAND how we charcoal mellow Jack Daniel's, after you've peered inside a charcoal mellowing vat.



We can show you how tiny drops of Jack Daniel's trickle slowly through room-high vats of tightly tamped charcoal. And we can tell you that nothing (not even aging) gives our whiskey more smoothness. After you've looked inside a charcoal vat, you'll always remember how we use them. After a sip of Jack Daniel's, we believe, you'll be glad we always will.



CHARCOAL MELLOWED DROP BY DROP

Tennessee Whiskey • 90 Proof • Distilled and Bottled by Jack Daniel Distillery
Lem Motlow, Prop., Inc., Route 1, Lynchburg (Pop. 361), Tennessee 37352
Placed in the National Register of Historic Places by the United States Government

¡Speak Spanish like a diplomat!

What sort of people need to learn a foreign language as quickly and effectively as possible? *Foreign Service personnel*, that's who. Members of America's diplomatic corps are assigned to U.S. embassies abroad, where they must be able to converse fluently in every situation.

Now *you* can learn to speak Spanish just as these diplomatic personnel do with the Foreign Service Institute's Programmatic Spanish Course.

The U.S. Department of State has spent tens of thousands of dollars developing this course. It's by far the most effective way to learn Spanish at your own convenience and at your own pace.

The Programmatic Spanish Course consists of a series of tape cassettes and an accompanying textbook. You simply follow the spoken and written instructions, listening and repeating. By the end of the course, you'll find yourself learning and speaking entirely in Spanish!

This course turns your cassette player into a "teaching machine." With its unique "programmatic" learning method, you set your own pace—testing yourself, correcting errors, reinforcing accurate responses.

The FSI's Programmatic Spanish Course comes in two volumes. You may order one or both courses:

☐ Volume I, Basic.
(11 cassettes, 16 hours), instructor's manual and 464-page text, $115

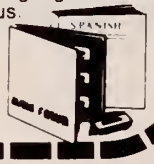
☐ Volume II, Intermediate.
(8 cassettes, 11½ hours), instructor's manual and 614 page text, $98
(New York residents add sales tax.)

Your cassettes are shipped to you in handsome library binders.

TO ORDER, JUST CLIP THIS AD and mail with your name and address, and a check or money order. Or, charge to your credit card (American Express, VISA, Master Charge, Diners Club) by enclosing card number, expiration date, and your signature.

The Foreign Service Institute's Spanish course is unconditionally guaranteed. Try it for three weeks. If you're not convinced it's the fastest, easiest, most painless way to learn Spanish, return it and we'll refund every penny you paid! Order today!

Many other FSI language courses also available. Write us.



Audio-Forum
Dept. B-22
145 East 49th St.
New York, N.Y. 10017
(212)753-1783

AUDIO-FORUM®

AUSTRALIA. CIVILIZED ADVENTURE.



Australia is unlike any other place on earth. You can walk back into time and leap into the future. All in the same day.

Join a rugged safari tour. Experience spectaculars like the vast Outback. The Great Barrier Reef. Living deserts and tropical rain forests.

Go game fishing, mountain climbing, camel-trekking. Ride around a sheep station. Pan for gold. Or hop off the trail and explore one of our cosmopolitan cities.

Send for our free Travel Planner. And take a tour of our continent before you come, mates.

See your Travel Agent or mail this coupon for your free Travel Planner.

Australian Tourist Commission
Distribution Center, P.O. Box A-1,
Dept. 151-013, Addison, IL 60101

My special interest is _____

Name _____

Address _____

City _____ State _____ Zip _____

helped themselves to a sheep, which they generally dragged outside and ate there. Local shepherds also reported the loss of single animals that went astray in a thick mist or on the way home. Many of these were eaten on the spot, with only their skin and heavy bones left over. It was not uncommon for wolves to leave behind animals that had been only nibbled at, however, presumably because they had been disturbed. The remains were generally eaten by dogs the following day.

Yet we also saw damage on a larger scale. It was not uncommon for as many as ten sheep to be killed, and on two occasions more than a hundred were dispatched. This always seemed to happen when panic broke out among the sheep and a large number ran about bleating wildly. To the wolves the activity was an irresistible signal to catch and kill, and like foxes in a chicken run, they killed everything they could. (A bear is said to have broken into a sheep shed in the national park, killed the more than one hundred sheep in it, and then gone to sleep out of sheer exhaustion, so that the next morning the shepherds found him asleep among the dead sheep.)

Such excesses of killing arise in the unnatural situation in which a predator is confronted with a large number of prey animals whose movements are restricted. In complete contrast to the killing of wild prey, nearly all of which is consumed, predators kill more domestic animals than they can use. Erki Pullainen reports similar findings from northern Finland. Of 149 sheep, 9 cows, 15 calves, and 3 horses killed by predators, only 31 sheep, 3 cows, 5 calves, and 1 horse were eaten.

This behavior is what causes the shepherds' very understandable hatred of predators, the wolf in particular. Losing a single sheep, a single foal, or a single calf on occasion would perhaps not be so bad. But for a predator to kill a hundred or more animals and then not even eat them is too much. Whenever a wolf has killed in this manner, the event has been widely reported in the newspapers, and hostility both to wolves and to the movement to protect them has become vociferous.

On the other hand, when a wolf meets a violent death, newspapers and television also report the event with horror, as happened when Luigi and I found 1/2, the first wolf we had tagged, dead in a stream in the na-

tional park area. The animal had obviously been killed with a shotgun by a poacher who had been shooting birds. It must have taken some time to die. Its body was carried along by the stream and finally ended up in the undergrowth by the bank where, guided by the transmitter, we eventually found it.

Other wolves marked by us also died at the hands of humans. At the very beginning of our work in the Maiella area we caught and tagged two adult females from neighboring packs. At least four other wolves, presumably an adult male and three cubs, were living with one of these females (7/8). The female had cubs again in the spring in a thick woods on the Cresta Maggiore above Cansano. Luigi found the den and saw two cubs, although there may have been more. This den was the rendezvous for the pack throughout the summer. In the winter that followed I succeeded in catching and tagging two adult males and two nine-month-old cubs, so that there were four members of the pack we could keep track of. Together these wolves roamed an area of about seventy-five square miles between Sulmona, the Passo San Leonardo, and Pescocostanzo. It was not long, however, before we found one of the cubs dead: it had swallowed strychnine hidden in the carcass of a sheep. And one of the adult males died soon after, also of strychnine poisoning.

Of the total of twenty-five wolves that we knew had died in the Abruzzi from 1974 to 1976, at least nine, chiefly young ones, died of poison. Three died of gunshot wounds and one was run over. For the others the cause of death could not be established. We have no information about wolves that die of natural causes—illness, old age, wounds, or undernourishment. But since of an estimated total of twenty-five wolves at least thirteen, and probably more, were killed in the course of two years, the chances of natural death cannot be very high.

Because of the wolf 's secretive way of living, we were not able to obtain an accurate picture of the nature of the population, that is, its age structure, the size of its social groups, its rates of reproduction, and so on. Observation of 7/8 and her pack showed that wolves in this area were able to form small packs, which remained stable for a time, and to lay claim to a territory that was defended against strange conspecifics. But the high death rate due to human agency, as well as living conditions that are greatly dependent on human beings, affects the spatial organization of the population, and such packs do not survive for long. The large amount of food required by young animals and the consequent increased pressure on domestic animals (when cubs are present) result in an increase in human persecution when a pack has been formed. The result is a surviving wolf population largely split up into small groups or individual animals that generally live on refuse and are able to reproduce and rear cubs successfully only in exceptionally favorable circumstances.

Our work in the Abruzzi showed very plainly the demands that the wolf makes on the living space it shares with humans. Apart from a sufficient food supply, a matter on which it is not exactly choosy, the wolf needs refuge areas that are to a large extent free of human disturbance. These can be either undeveloped forest areas or mountainous regions with forests and steep ravines. In any case, in the Italian distribution area we found no region where woods or mountains were lacking and wolves survived. In this

Get the Lion's share!

High Yields. Plus

Daily dividends!
Daily compounding!
Daily liquidity!

You get all this when you invest in Dreyfus Liquid Assets, the high yielding money market fund:

Dividends are declared and compounded daily. You get free checks for cash as you need it, or to pay larger bills. And you keep on earning today's high money market yields until your redemption check clears.

There is no sales charge, there's no penalty for early withdrawals--you can even redeem your investment by phone. Start with just $2,500. Additions can be as low as $100.

'Learn how you can get the Lion's share of today's money market rates. Send coupon or call today.

Dreyfus Liquid Assets---

For more complete information, including management fee charges and expenses, obtain a prospectus by sending this coupon. Read it carefully before you invest or send money.

Name_____

Address_____

City_____

State_____ Zip_____

2260106 0387

Post Office Box 600
Middlesex, NJ 08846

FOR A PROSPECTUS

Call toll free, day or night, 7 days a week

1-800-345-8501
Extension 408

In Pennsylvania
1-800-662-5180
Extension 408



RUGGED The finest grade of 100% cotton chamois in a heavyduty weight. Soft enough to wear next to your skin. Full cut. Long sleeves and shirttails. Collar lined with smooth whisker-proof nylon. Grows more comfortable with every washing. **Colors:** Red, Tan, Navy, Brown, Light Blue, Rust, Green. **Sizes:** Men's S/M/L/XL.

Chamois Cloth Shirt $23.50 ppd. **SOFTIES**

Order Today! Money Back Guarantee!

Here is my check or money order for $_____ (Add sales tax where applicable.)

Please RUSH my #1462 Chamois Cloth Shirt.

Size _____ Color _____

Name _____

Address _____

City _____

State _____ Zip _____

☐ Send me your FREE color catalog of quality outdoor apparel and equipment.

Eddie Bauer®

Dept. CNH, Fifth & Union, Seattle, WA 98124

easter eggs



The colors of the rainbow adorn these delicate eggs from Czechoslovakia. Each egg is painstakingly decorated with traditional folk designs — some drawn with warm wax and dyes, some gaily hand painted . . . all are different! One dozen eggs $17.50 postage paid.

Send $1.00 for 48 page catalog

shopping international®

dept. 435

norwich, vermont 05055

connection the effort of the Italian forest administration to reforest many cleared mountain regions is certainly a positive factor.

To conclude our work in the Abruzzi, my wife and I flew along the Apennines from Florence in the north to Calabria in the south. We wanted to find out what the country looked like in between the high mountain areas where Luigi had originally concluded that wolves still survived. We spent four days crisscrossing the mountains, and found no distribution area that seemed to be completely isolated from the rest. Thus, according to the present state of our knowledge of their behavior, wolves should be able to roam from Monti Sibillini in the north of the Abruzzi to Monti della Sila in the south. That would make their final extinction in Italy more unlikely than we had originally supposed.

It soon became clear to us that their survival, whether they lived in isolated enclaves or in contact with one another, depended on doing away with their total reliance on humans. This could be accomplished only by large-scale reintroduction of their natural prey. The red deer was exterminated in the Abruzzi in the nineteenth century, but a small population of roe deer survived in the national park area up to the 1960s. The principal cause for the disappearance of both species must have been hunting, although the competition resulting from overintensive grazing of domestic animals may also have played a part.

In 1971 and 1972 a total of forty-five red deer from Yugoslavia and twenty-one roe from northern Italy were set free in the national park. When our project began a year later, little was known about their whereabouts. The red deer had evidently established themselves in the vicinity of their point of release, but the roe seemed to have disappeared again.

We therefore proposed that more animals of both species should be released and that they should be studied with a view to gaining knowledge and experience for further large-scale reintroductions. We were particularly interested in how they would multiply, the influence they would have on the vegetation, and their interactions with domestic animals, as well as with the wolf and the bear. Between 1974 and 1977 a total of twenty-eight red deer and sixteen roe were released at various places in the national park. The

international nature tours



Galapagos Islands/ Headwaters of the Amazon/Ecuador/ Peru/Patagonia/ Falkland Is./Kenya Tanzania/Rwanda Gorilla Safari/Costa Rica/Nepal/New Guinea

Expert Naturalist Guides
Very Small Groups

Write: **WILDERNESS TRAVEL*** 1760-NJ Solano Ave., Berkeley, CA 94707 (415) 524-5111

**formerly So. American Wilderness Adventures*

CUT TOUGH TOE-NAILS DOWN TO SIZE

EVEN INGROWN NAILS

QUICK, SAFE, EASY!



SURGICAL TOE-NAIL SCISSORS

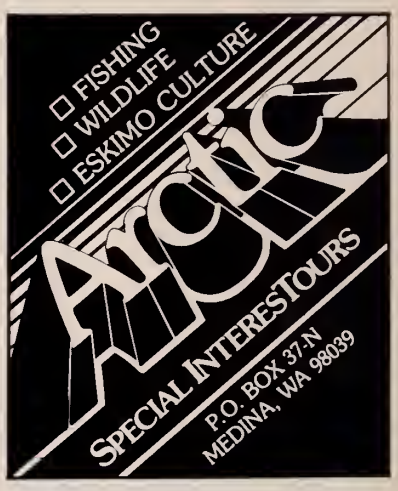
ONLY $3.99 + 50¢ hdlg

SPECIALLY DESIGNED TAPERED BLADES

Extra long shanks for greater leverage. Surgical tapered blade slides under ingrown nails for fast, safe removal. For all trimmings, pedicure, manicure. Strong, stay sharp steel from Solingen Germany, 4" long.

One Pair $3.99 + 50¢ handling
Two Pairs $6.98 + 50¢ handling
Full money back guarantee.

Med Ind. Inc. Dept. 46
1113 E. Wendover Ave., Greensboro NC 27405



WHEN YOU WRITE TO NATURAL HISTORY

about a subscription renewal, billing, or any kind of adjustment, please include your present address label.

Moving? Please notify 6 weeks in advance. Send your present address label along with your new address to Natural History Membership Services, Box 4300, Bergenfield, NJ 07621.

Name _____

New Address _____

_____

City _____ State _____ ZIP _____

Please Print **Attach Label**

deer all came from the Bavarian Forest National Park, presented by the Bavarian Ministry of Agriculture as part of a joint operation between the Abruzzi and Bavaria. This certainly reflected credit on the minister of agriculture, who exposed himself to severe criticism from the political environment from which he came. The press talked of "German deer for Italian wolves," and the sporting community was not exactly friendly either.

Critics frequently cited Italy's annual "massacre of birds" as a reason to abandon the project, claiming that as long as such a disgraceful state of affairs prevailed in the country, "ecological development aid" should not be granted in other areas. But these arguments do not hold water. Certainly a stop should be put to the shooting of millions of birds, including migratory species, that takes place in Italy each year. Nobody is more aware of that than the Italian conservationists. The Italian shooting of birds has become ecologically intolerable. But even this massacre is not as bad as depriving species of their living space by draining the last marshes, straightening the course of rivers, turning natural forests into pine plantations, and making wholesale use of poison in agriculture and forestry—all because of the compulsion to exploit every last square foot of land in Central Europe.

Our object in introducing deer was not merely to supply wolves with living meat, but to reestablish ecological conditions destroyed by human beings, including hunters. Not only should wolves have their natural prey, but red deer and roe should get back their natural predator—an act of ecological "reparation" that we hoped would benefit the disrupted living community of the selected territories.

The deer established themselves well. In the summer of 1976 there were already 130. At first they settled in the surrounding valleys, but soon some individual animals had advanced as far as the neighborhood of Sulmona. We know little about the effect they have had on the vegetation. In the national park area I saw large areas of willow herb that had been stripped bare. But in areas where there is no grazing of domestic animals, the vegetation is so luxuriant that there would still be a place for a great many more deer, and even in grazing areas it should be possible to maintain a limited number.

During the years of our work in

ses·qui·cen·ten·ni·al



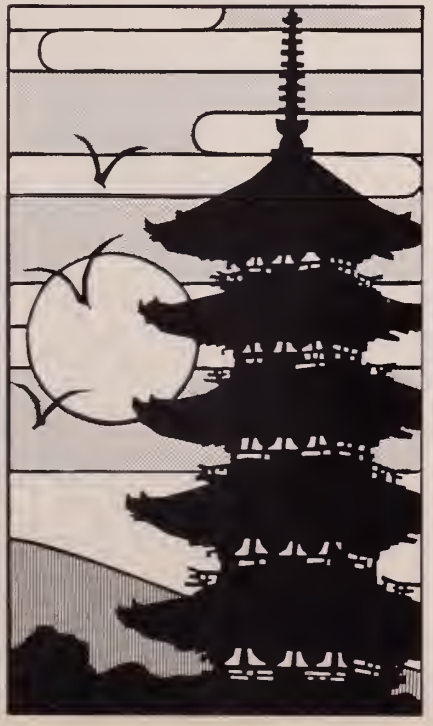
Webster's New Collegiate Dictionary.
It's where the words live.

For 150 years, G. & C. Merriam has been bringing the language to life and life to the language. Today, the best-selling Webster's New Collegiate offers 150,000 words, including 22,000 new entries. Get a taste of "Fast Food," feel an affinity for "Clone," and share in the celebration of our "Sesquicentennial." In 150 years, dictionary has never meant so much. Just $12.95, indexed. A gift of lasting value.

FROM MERRIAM-WEBSTER®

© G &C MERRIAM 1980

Small Ad for
a Big Tour of the Orient



Japan Air Lines has 35 very special tours to the Orient. Come, let us take you to the Orient of your dreams. Here is but one example: Imperial Japan, 15 days, $1815. Includes Tokyo, Lake Kawaguchi, Matsumoto, Takayama, Kanazawa, Awara Spa, Amanohashidate, and Kyoto. Local escort. Optional meal plan available. Deluxe and First Class hotels.

Rates based on double occupancy and economy air fare from the West Coast and are subject to change. Additional charge for June–October peak season.

CALL TOLL FREE
800-835-2246,* Ext. 143
for free tour information, see your travel agent, or mail this coupon today.
Japan Air Lines, P.O. Box 10618
Long Island City, New York 11101

JAL HAPPY HOLIDAYS
JAPAN AIR LINES

Dear JAL: I've read your small ad and I'd like more details of the tours I've checked.
☐ Imperial Japan (5004)
☐ Other Happy Holidays Tours

Name_____
Address_____
City_____ State_____ Zip_____
Travel Agent_____ NH 0281

*Continental U.S. only. In Kansas: 800-362-2421

Iceland Greenland

Cruising expeditions to Iceland / Greenland



Polar bears, walrus, exceptional birdlife, Eskimo villages, Norwegian fjords, Spitsbergen. Informative lectures by expert naturalists. Fine accommodation / cuisine on our MS WORLD DISCOVERER — the world's most sophisticated expedition ship. Rates from $4400. Departs July and August. Write for details.

Society Expeditions Cruises Inc.
723 Broadway E
Seattle, WA
98102 USA

Name NH-2

Street

City / State / Zip

Cruising expeditions also to: ☐ Amazon ☐ Antarctica ☐ New Guinea ☐ Indonesia ☐ Seychelles ☐ Red Sea ☐ Iceland / Greenland

M. S World Discoverer Registered in Singapore

Better Than Jogging



NordicTrack

Jarless Total Body Cardiovascular Exerciser Duplicates X-C Skiing for the Best Motion in Fitness

This revolutionary new exerciser duplicates the smooth, rhythmic, total body motion of X-C skiing for the most effective cardiovascular exercise obtainable. Uniformly exercises more muscles than any other exercise device. Makes high heart rates easy to obtain and keeps more muscles in tone. Also highly effective for weight reduction.

Completely jarless natural motion does not cause joint and back problems as in jogging or running. Arm and leg resistances are separately adjustable for maximum effectiveness. The NordicTrack uses no motors and folds compactly for convenience. Used in homes, businesses, and institutions. Our customers include Xerox Corporation, US Army, Penn State U and the YMCA.

For more info: PSI toll free 800-328-5888
124 L Columbia Court Chaska, MN 55318

the national park we found the remains of three deer killed by wolves. One was a weak female that had been killed soon after being released, and the other two were young males that had been cornered by the wolves in impassable woodland. But the growth of the population shows that the wolves exercise little regulatory influence. The deer are presumably too big, in general, to be brought down by a single wolf or even a small pack. It would be interesting to investigate possible changes in the social organization of the wolf resulting from adaptation to the new kind of prey.

There is no doubt that unless fundamental changes are made soon the days of the wolf are numbered in the Abruzzi, as elsewhere in Italy. In the course of our fieldwork the necessary changes became very clear to us. All hunting of wolves would have to cease, as would the use of poison to combat foxes or other wild animals. Moreover, no more refuge areas vital to the wolf could be destroyed by the building of roads and ski lifts. Thus our primary concern was to secure action at the legislative level, although it was clear to us that the best laws would be of no avail unless the wolf was accepted by the local population. Hence we had to investigate the attitude of people in the locality and discover the conditions under which they would be willing to accept the wolf.

We made our first efforts in this direction when we began work in the area in March of 1973. Our methods of interrogation would not have been regarded as scientifically acceptable in sociological circles, but we asked a number of people whether they thought wolves were dangerous to human beings. Our "impressions" (I use the term to avoid saying "findings") were interesting. The farther we were from the areas in which wolves lived, the more dangerous they were believed to be. In areas inhabited by wolves the people least impressed by the animals' alleged dangerousness were those who had direct contact with them. All the shepherds we asked agreed that the wolf was not a threat to human beings. The occupational group that regarded the wolf as especially dangerous was, interestingly enough, innkeepers.

Our impressions were confirmed two years later by a proper scientific inquiry we conducted in cooperation with the Sociological Institute of the University of Rome. The questioning

Joseph L. Sax

Mountains Without Handrails

Reflections on the National Parks



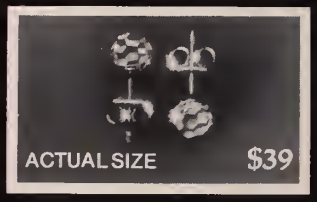
Sax proposes a novel scheme for the protection and management of America's national parks, giving perspective to the longstanding and bitter battles over use of our national parklands: hikers vs. cyclists; ski resort developers vs. wilderness advocates; "industrial tourism" vs. recreational "elitism."

$10.00/*paper* $5.95

The University of Michigan Press
Dept. OM P.O. Box 1104
Ann Arbor, MI 48106



ELEGANCE IS



CRYSTAL & GOLD

Elegant pure Austrian full lead Strauss crystal wedded with 14 carat gold. Earrings presented royally ensheathed in a golden gift box. The perfect gift—or a treat for yourself.

Call toll-free 800/453-8777

☐ Please send _____ pairs of Crystal & Gold earrings at $39.00 per pair. Sent first class postpaid. Money back guarantee. Texas residents add 5%.

☐ Check ☐ Visa ☐ MasterCharge ☐ Am. Ex

Card No. _____ Exp. _____

Name _____

Address _____

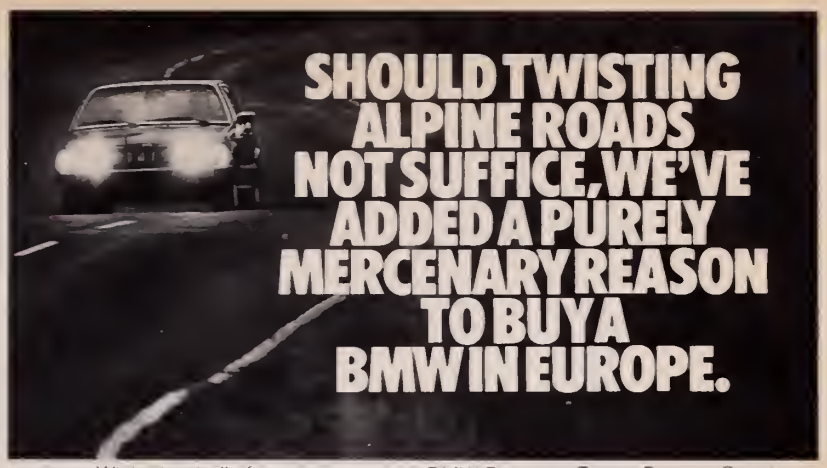
_____ Zip _____

CRYSTAL PALACE
Shoal Creek • P.O. Box 49292 • Austin, Texas 78765

took place in a number of villages in the Maiella area. By that time our work with the wolves had been given a great deal of publicity, most of it favorable. Besides a number of television films, there had been many reports in the press, the local radio station had shown a great deal of interest, and Luigi had delivered a number of lectures. So there was practically no one in the area who did not know us or, at any rate, our Land Rover, which with its impressive array of aerials was on the move by day and by night. Our campaign, as well as that of the WWF, against plans to establish a new ski resort on the Passo San Leonardo was also known. Instead of a ski resort, we proposed the establishment of another national park or at least a regional park in the Maiella. Hunting would be forbidden there, and red deer and roe would be introduced. Instead of building big hotels financed from Rome and Milan, we suggested that the beautiful old villages should be restored, facilities for overnight visitors extended, and small pensions established. Our proposals looked rather unfashionable in comparison with the spectacular plans to develop the Maiella with ski lifts, a golf course, hotels, and holiday homes, but they would benefit the local people, and the kind of tourism they would attract, although it would bring in less money, would not be so seasonally limited.

The inquiry showed very clearly that people's attitude toward the wolf depended largely on their interest in the various possible alternatives for the future development of the area. Those who lived in the lower-lying areas, who would neither suffer damage from the wolf nor benefit from the development of the Maiella into a ski track, were generally in favor of the wolf and its protection. The cultural aspect—the desire not merely to exterminate a creature that had made such a mark on the history of the area—played an important part. Surprisingly, even shepherds were favorably inclined to the wolf. Indeed, they had no objection as long as the number of wolves did not get out of hand and compensation was paid for any damage they suffered. They also favored the idea of introducing red and roe deer, which would relieve wolves' pressure on their sheep.

I find this attitude on the part of the shepherds quite remarkable. In spite of the traditional warfare between wolf and shepherd, the shep-



While the thrill of mastering a spiny Alpine road in the BMW built for it remains as potent as ever, we recognize that these are value-conscious times.

We are therefore pleased to announce that a BMW bought in Europe is now substantially less expensive than one bought in the United States.

Further, if you imagine that the joys of European Tourist Delivery are clouded by 42-page forms, rest assured. Because your BMW dealer here at home handles everything.

BMW European Tourist Delivery Program, Montvale, New Jersey 07645

Please send me more information on your 1981 European Delivery Program

NAME _____

ADDRESS _____

CITY _____

STATE _____

ZIP _____

THE ULTIMATE DRIVING MACHINE.

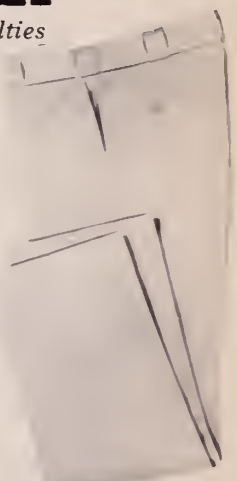
BMW MUNICH GERMANY

© 1981 BMW of North America, Inc. The BMW trademark and logo are registered trademarks of Bayerische Motoren Werke A.G.

L.L.Bean

Outdoor Sporting Specialties

Chino Pants
(For Men and Women)



You'll get more wearing pleasure from these pants than any others you own. Made of high grade combed cotton/polyester twill. Permanent crease, washable. No ironing required. Neat looking for sports or work. Color, Light Tan. Men's waist sizes: 24, 25, 26, 27, 28, 29. Inseams 30″ and 32″. Even waist sizes 30 to 44 plus 31 and 33. Inseams 29″, 30″, 31″, 32″, 33″ and 34″.

Lined Chinos



Same sturdy construction but fully lined with our famous tan Chamois Cloth, a comfortably warm 100% cotton flannel. Men's even sizes 30 to 44. Inseams 29″, 30″ and 32″. Women's even sizes 8 to 20. Inseam 31″.

Please Ship Postpaid

__#1822W Mn's + Wm's Chinos @ $14.00
Size_____ Inseam_____

__#1824W Men's Lined Chinos @ $23.00
Size_____ Inseam_____

__#4435W Wm's Lined Chinos @ $23.00
Size_____

☐ Check Enclosed ☐ Master Card
☐ VISA ☐ American Express

Card Number _____
Exp. Date _____

☐ SEND FREE CATALOG

Name_____
Address _____
City _____
State_____ Zip_____

L. L. Bean, Inc., 702 Casco St., Freeport, ME 04033

herds' attitude was one of tolerance. Hunters, however, were less favorably inclined. Although the wolf was hardly a competitor for "their" prey, their attitude was negative, and they frequently complained about the damage done to domestic animals. Finally, those who hoped to benefit from a skiing circus on the Maiella were definitely opposed, either because they wanted to build hotels or because they owned land they hoped to sell at a high price. The people of Pacentro, in whose communal area the ski lifts and hotels were to be built, were particularly hostile. The woman who conducted the inquiry was once actually thrown out of the village as a Communist agent.

People in the villages through which we often drove, many of whom knew us personally, were much more favorably inclined, although here too their attitude basically depended on where their interests lay. Indeed, there were people with whom we were on the best of terms and who were accessible to our arguments who, if they could, would have hunted down every last wolf.

The inquiry showed plainly that conservation work cannot succeed in the long run if it is against the interests of the local people, however questionable those interests may be. Rather, a conservation effort must attempt to get the majority of the population on its side by a conciliatory approach, by putting forward alternative development plans, by a willingness to pay compensation for lost rights, and by a great deal of factual explanation that does not attempt to conceal the existence of opposing interests. People should not be allowed to feel that conservationists are going to decide what is to happen in their neighborhood without consulting them. Instead they must be persuaded that conservationists consider the interests of the neighborhood as well. This may prove to be a long, difficult, and thoroughly political task, a fact not always sufficiently understood in conservation work. I believe that in the Abruzzi we succeeded in at least making a start at integrating our conservationist goals into an alternative view of ecological and economic development that will ultimately be more beneficial to the people of the area.

But it is not only at a local level that the future of the wolf and the values for which it stands will be de-





Enter the world of Questers nature tours.

When you travel with Questers, you have the advantage of our knowledge of the travel world. And our experience of the natural world. We are travel professionals. And our only tour program is Worldwide Nature Tours.

Under the leadership of an accompanying naturalist, we search out the plants and animals, birds and flowers... rain forests, mountains, and tundra... seashores, lakes, and swamps of the regions we explore. At the same time, we include the more usual attractions in touring—the cities, archaeological sites, and people.

The current Directory of Worldwide Nature Tours describes 29 tours varying from 9 to 36 days and going to virtually every part of the world. Included are The Amazon, Peru, Patagonia, Galapagos, Hawaii, Alaska, Death Valley, Everglades, Ladakh, Sri Lanka, Iceland, Scotland, Greece, Australia, and New Zealand. Tour parties are small, the pace leisurely, and itineraries unusual.

Call or write Questers or see your Travel Agent today for your free copy of the Directory of Worldwide Nature Tours.



QUESTERS

Questers Tours & Travel, Inc.
Dept. NH 381, 257 Park Avenue South
New York, N.Y. 10010 • (212) 673-3120

A Taste of India
with
Nepal-Sri Lanka-Bhutan Burma-Thailand

Journeyworld offers you the architectural splendours and unforgettable sights of some of the world's most creative civilisations.

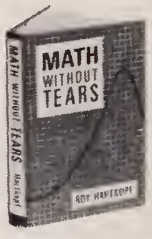
You will see the Taj Mahal, Kathmandu in the Himalayas, the stupendous rock carved temples of Ajanta & Ellora, Bhutan a fairy tale Buddhist kingdom, colorful Kandy in Sri Lanka, the glory of Pagan and Mandalay, the elephant camps and tribal villages of Chieng Mai.

The programs include comprehensive sightseeing, deluxe hotels and all meals.

For brochures write to:

JOURNEYWORLD INT'L LTD.
155 EAST 55th STREET
NEW YORK, N Y 10022
TEL (212) 752-8308

MATH WITHOUT TEARS



Using non-technical language and a light touch Roy Hartkopf gives you a basic understanding of many everyday applications of mathematics. He takes the reader from simple counting to trigonometry and calculus, emphasizing the practical aspects of math. Humorously written. *Learn math in the comfort of your own home at minimum cost.*

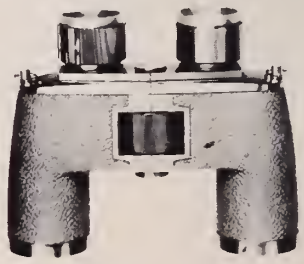
Order Now: $9.95 plus 95¢ hdlg.
EMERSON BOOKS, INC.
Dept 493-F Buchanan, N Y 10511
10 Day Money Back Guarantee

ALASKA EXPERIENCES

LEISURE

Tours designed for adventurous, discriminating travelers, featuring out of the way destinations, rafting, bush plane flightseeing, Ferryliners, Misty Fjords, Katmai, and the Arctic.

For Brochures Write:
Alaska Adventure Tours
3436 Tongass Ketchikan, Ak. 99901



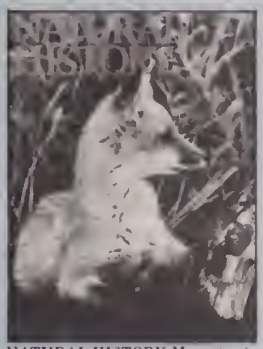
BUSHNELL 7x35 CUSTOM
Mfg. List $280.00 Postpaid $164.00

This is an example of the deep discount prices on high quality optics that is found in our FREE catalog. This catalog lists and illustrates an outstanding selection of telescopes, binoculars etc., plus valuable information on how to properly select them. Write for it today.

GIL HEBARD OPTICS
COURTHOUSE SQ., KNOXVILLE, ILL. 61448

Again, we're only $15 a year

HISTORY REPEATS ITSELF



NATURAL HISTORY Magazine is published by the American Museum of Natural History, New York, N.Y. Please allow 7 weeks for delivery of first issue. Outside U.S. please add $3 per year for postage. Offer void after 7/31/81

History repeats itself in the new year by offering you membership in the Museum of Natural History and 12 galvanizing issues of NATURAL HISTORY Magazine at last year's low price of just $15.

☐ YES, send me 12 months of NATURAL HISTORY for just $15 (I save $9 over the newsstand rate) and my museum membership which is included in my subscription.

NAME_____

ADDRESS_____

CITY_____ STATE_____ ZIP_____

Include a gift membership for:

NAME_____

ADDRESS_____

CITY_____ STATE_____ ZIP_____

I PREFER TO INCREASE MY SAVINGS AND ENJOYMENT:
☐ Send 2 years at $26 ☐ Send 3 years at $35

J488

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO. 30 BERGENFIELD, NJ

Postage will be paid by addressee

NATURAL HISTORY
P.O. Box 4200
Bergenfield, New Jersey 07621

sential role. In this respect Luigi and the WWF succeeded in attaining two objectives that are vital to the survival of the wolf. Shortly before my departure from Italy in December 1976 the Agriculture Ministry in Rome made the wolf a permanently protected animal throughout the country and prohibited the use of poison for predator control. We were especially pleased by this last prohibition because it was so unexpected and so important, not only to the wolf.

What does the future hold for the wolf in Italy? Everything depends on how these two laws are observed. And that depends on the attitude of the local population, which in turn depends on the future economic development of the higher-altitude areas in the Apennines. If compensation regulations were introduced in the southern provinces, as they have been in the Abruzzi and more recently in some other provinces, another step in the direction of tolerance would be taken. A reasonable development of tourist facilities would presumably also be beneficial, since the economic base would be broadened and the great dependence on sheep, which has prevailed in the past, would be diminished. Economic prosperity is certainly one of the essential conditions for the preservation of the wolf. But every mountain need not be equipped with skiing facilities and every village need not have a big hotel. This would be not only an ecological disaster for the wolf and other free-living animals but also an economic dead end for the people of the area.

Finally, the future of the wolf depends on the success of the prey introduction program. Whether red and roe deer will be able to survive outside strictly protected areas, such as the national park, depends on Italian sportsmen. This is certainly a factor of great uncertainty, and I must admit that my hopes in this respect are not very high. Deer and chamois are strictly protected, and the penalties for shooting them are severe. But who is to insure that the law is enforced? Our hopes lie with the forest administration, whose attitude toward introduction is very positive. Also the sportsmen of central and southern Italy do not have a tradition of hunting ungulates, and shooting in the forest is prohibited. Perhaps, after all, there is a chance that deer, wolves, and human beings will be able to coexist in developed and cultivated areas. □

ALASKAN WILDLIFE ADVENTURE

June 26 to July 9, 1981

Join Kenneth A. Chambers, Lecturer in Zoology at the American Museum, for a journey to America's last great frontier. Cruise through fabulous Glacier Bay, with its whales, seals, and teeming birdlife. Explore scenic Mt. McKinley National Park, and see giant moose, white mountain sheep, barrenground caribou, and golden eagles. Visit volcanic Katmai, and watch brown bears fishing for salmon. Fly to the remote Pribilof Islands, summer home to over a million fur seals and countless nesting sea birds. Limited to 25 participants.

write to:
DISCOVERY TOURS
AMERICAN MUSEUM OF NATURAL HISTORY
Central Park West at 79 Street New York, New York 10024
Call: (212) 873-1440



Oriental Shou motif, deeply etched on a set of 6 double old fashioned glasses #111 $22 Members $19.80 Matching 2 qt. Pitcher #112 $25 Members $22.50

Long Life!



American Museum of Natural History
Museum Shop Dept. 228
P.O. Box 174
Scarsdale, N.Y. 10583

Please print
Name
Address
City State Zip

Item #	Qty.	Description	Price	Shipping/ handling	Total
111		Glass set of six		3.00 per set	
112		Pitcher		2.50 each	

Customer Inquiries: Call 212 799-8958

Most deliveries will be made by U.P.S. so please provide street address.

Order Total
N.Y. State Tax
Total Amount

Member Membership # Non Member

I've enclosed check or M.O. in the amount of $ payable to American Museum of Natural History (NO C.O.D'S)

Charge To: Master Charge Visa American Express

Account # Exp. Date

Signature (req. if using credit card)

Armstrong House
decorative accessories catalog
Armstrong

Page after page of decorator selected accents, from fun and practical items to exquisitely hand-crafted artwork can be found in our catalog. Beautify your home . . . or find unforgettable gifts. Send $2.00 for the next 3 issues.

Armstrong

Direct Response, Inc.*
Dept. 12SNH, 313 W. Liberty St.
Lancaster, Pa. 17604

Enclosed is $2.00 for the next three issues of *Armstrong House*.

Name

Address

City State Zip

*A subsidiary of Armstrong World Industries.



Nature & Cultural Expeditions

Combine adventure, discovery, learning and vacation on expeditions to unique environments worldwide!

In 1981, join NEI in Baja California • Nepal Australia • New Zealand • Ecuador & Peru New Guinea • Galapagos • Sea of Cortez Hawaii • Tanzania & Kilimanjaro • Alaska Peru & Easter Island • Bhutan • Scotland Patagonia & the Falklands • Canyonlands Polynesia • Kashmir & Ladakh • Costa Rica Yucatan & Guatemala • Indian Country Kenya • Japan & Others Worldwide!

Leisurely expeditions for groups of eight to twenty led by experts in natural history or anthropology. Superb photography.

Nature Expeditions International 599 College Ave. • Dept. NG Palo Alto, CA 94306 (415) 494-6572

Seyfert Galaxies

These peculiar objects resemble quasars in many respects, and they are equally puzzling

by Eugene R. Capriotti

Next to the sun, the moon, and Saturn, the spiral galaxies, because of their distinctive structure, are the most easily recognizable of astronomical objects. Billions of these flat pinwheels, each containing hundreds of billions of stars, are strewn throughout the universe.

The spectrum of a spiral galaxy is generally what one might expect for an object containing a myriad of individual stars. A small percentage of spiral galaxies, however, in addition to a composite stellar spectrum, have spectral features that cannot be produced by a conglomeration of isolated normal stars. These nonstellar spectral features are produced by hot ionized gases having a wide range of density and excitation. The first spiral galaxy with these special features was discovered in 1943 by Carl Seyfert, then working as a postdoctoral fellow at the Mount Wilson Observatory in California. Each similar object that has subsequently been discovered has been called a Seyfert galaxy. The most distinctive structural feature of the Seyfert galaxies is that they have very small, extremely bright central regions called nuclei in which their peculiar spectra are produced.

Little attention was paid to the nuclei of Seyfert galaxies until after Maarten Schmidt, an astronomer working at Palomar Mountain in California, showed in 1963 that quasars have extremely large spectral red shifts, indicating that they are receding from us at speeds approaching the speed of light. Interest in quasars, on the other hand, has practically dominated extragalactic astronomy since the early 1960s, and it is the resemblance of the nuclei of Seyfert galaxies to quasars that has generated a great deal of interest in the Seyfert galaxies as well.

What makes the quasars so interesting is that their very large spectral red shifts are probably due to the recessional velocities associated with the general expansion of the universe (see "Quasars Confirmed," *Natural History,* February 1980). If that hypothesis is so, quasars, as a class, are the most distant objects in the universe because, as a class, they have the greatest spectral red shifts. If the quasars are very far away, then they are generating energy at a rate far in excess of the rate of energy production of a normal spiral galaxy made up of hundreds of billions of stars.

Quasars are also extremely small by galaxy standards. The brightness of some of these objects varies greatly over periods of time as short as a few weeks, consequently their diameters can be no greater than the distance traveled by light in the same time. This distance is about 100 times smaller than the distance from the sun to its nearest neighbor star, which is about four light-years away. In comparison, the diameter of our Milky Way galaxy is about 100,000 light-years.

The problem with the quasars is to understand how relatively compact objects generate more power than an entire galaxy of stars. That is also the problem with Seyfert nuclei, which in many cases produce more power than their parent galaxies. Scientists believe that if the question of energy generation in the nuclei of Seyfert galaxies were to be solved, the problem of energy generation in quasars might be solved automatically. Because of their similarity to Seyfert nuclei, quasars are viewed as being extremely bright.

nuclei of galaxies too far away for any part of the galaxy other than the nucleus to show up on photographs. In short, quasars can be considered to be very distant Seyfert galaxies, and Seyfert galaxies can be considered to be relatively nearby quasars.

Quasars are generally more luminous than Seyfert nuclei. As a class, however, the quasars are more distant than the Seyfert nuclei, which means that because of the finite speed of light, the energy generated by quasars reveals an earlier epoch in the history of the universe than does light coming from Seyfert galaxies.

The rate at which energy is generated in an active nucleus of a galaxy may depend on the age of the parent galaxy; perhaps the younger the galaxy with an active nucleus, the more luminous the active nucleus. In addition, since the quasars are so distant, the fainter ones are difficult to spot and the average luminosity of quasars might tend to be artificially enhanced by the observational selection of the brighter ones. In any case, the belief persists that quasars and Seyfert galaxies are different in degree but not in kind.

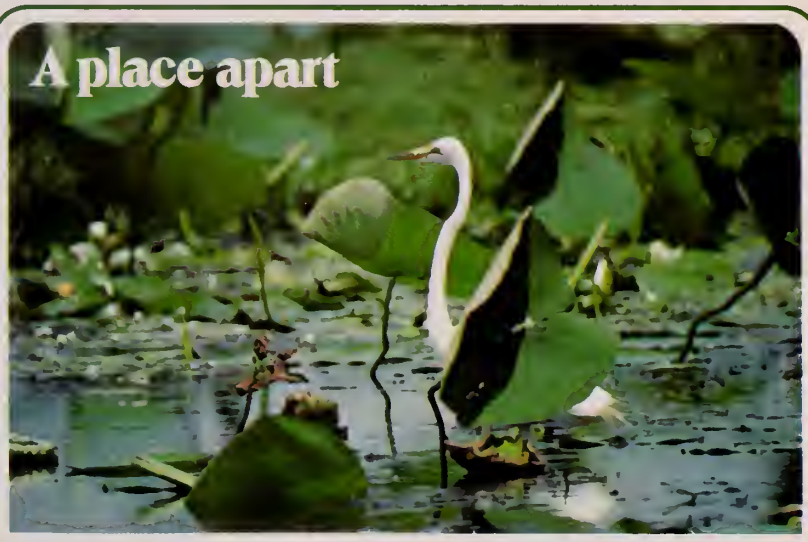
Theories attempting to account for the activity in the nucleus of a galaxy begin with the idea of a large mass concentrated at the center of the galaxy. Observational evidence of both Seyfert galaxies and quasars points to the accumulation of such a mass in a region with a diameter no larger than one light-year across and the mass being between one million and one billion times the mass of the sun. That is a very small area for a mass of such dimensions. The three basic forms of mass concentration upon which the various theories proposed

Smaller can be better, as the new full-power Nikon Roof Prism Compact Binoculars clearly demonstrate. Pocket-size slim and just 7-1/2 ounces light, they outperform many bigger and heavier binoculars in sharp, bright, distortion-free viewing. You see the entire scene, even while wearing glasses. And, most important, they're so precisely engineered that you can view for extended periods, without strain or discomfort. Available in all-purpose 6x, 7x and 8x models. See the difference Nikon quality makes, at Nikon camera dealers and selected optical departments. Or write to Nikon Inc., Dept. N-26, Garden City, New York 11530. Subsidiary/Ehrenreich Photo-Optical Industries, Inc.

SMALL WONDER



NIKON ROOF PRISM COMPACT BINOCULARS



The thing that makes a Louisiana vacation different is that Louisiana is different. From the primeval beauty of a wilderness called Atchafalaya, to its easy Mediterranean approach to living. Southern courtliness and subtropical greenness, Louisiana is the exotic sister in the family of American states.

Louisiana Office of Tourism
Dept. NH1 · P.O. Box 44291
Baton Rouge, LA 70804

Send me your new guidebook to Louisiana.

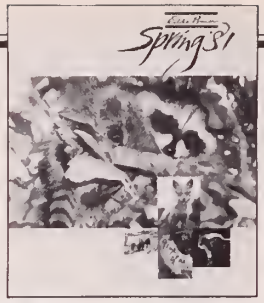
Name _____

Address _____

City _____

State _____ Zip _____

Louisiana. What a way to get away.



FREE CATALOG

Our brand-new Spring Catalog has all you need to make the most of outdoor adventures. It's packed with the finest equipment and clothing...all made to our exacting standards and backed by our Guarantee of Satisfaction or your money back. Send for your copy today and see why we've been the most trusted name in outdoor outfitting for more than half a century!

☐ Send me your FREE outdoor catalog.

Name _____

Address _____

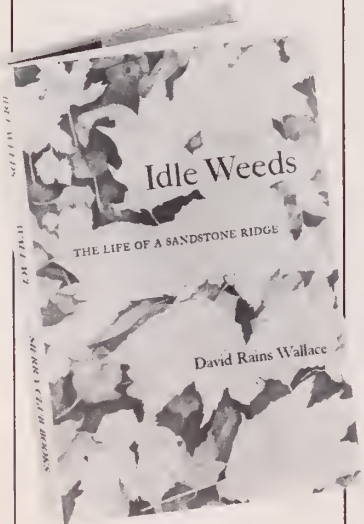
City _____

State _____ Zip _____

Eddie Bauer®

Dept. CN2, Fifth & Union, Seattle, WA 98124

"Wallace is without question one of the best nature writers of our day." —Country Journal



The author of the acclaimed *The Dark Range* takes us on a fascinating year's visit to an Ohio ridge teeming with a remarkable variety of life. "Delightful."—Toledo Blade

53 pencil drawings. $12.95

A SIERRA CLUB BOOK

for active galactic nuclei have been based are: (1) a dense star cluster, (2) a supermassive star, and (3) the accretion of material onto the perimeter of a black hole—a black hole being a concentration of mass with a gravity so strong as to prevent the escape of anything, including light.

There are two ways in which energy might be generated by a dense star cluster at a rate far in excess of the rate at which energy is produced by the normal nuclear processes that occur in the member stars of normal clusters. If the cluster is dense enough, collisions between its member stars could take place, causing the stars to break apart and thereby release energy at a rate in excess of the rate at which the stars normally shine. In such a case, the rate of energy production could even be far in excess of the rate of energy production of an entire galaxy of stars.

However, a sufficiently high rate of energy production is not the only criterion that must be met in order to explain the activity in a quasar or the nucleus of a Seyfert galaxy. The concentration of mass must also be able to provide the necessary power for the estimated lifetime of the active stage. If the extreme activity that occurs in the nuclei of Seyfert galaxies occurs in all spiral galaxies sometime during the lifetime of the galaxy, then the percentage of Seyfert galaxies would be the same as the percentage of the time that any spiral galaxy spends in the active stage. Present estimates indicate that about one percent of spiral galaxies are Seyfert galaxies. That means that if a spiral galaxy does in fact live for about ten billion years, as we believe, the active stage of the galaxy lasts about one percent of that time, or for one hundred million years.

In the case of dense star clusters, the necessary rate of energy production apparently would not be sustained for the necessary length of time. The cluster, continually losing energy through star collisions, would condense into a supermassive star or a black hole in a period of time shorter than that required to account for the frequency with which the galactic activity is observed.

Another possibility involving dense star clusters that has also been explored is the coalescence of stars due to collisions. In this picture, the more massive stars of the cluster merge into bigger and bigger stars by colliding



University of California, Santa Cruz

JOIN A WILDLANDS RESEARCH TEAM IN THE MOUNTAIN WEST OR CANADA

- Wildlife Research
- Wildlands Research
- Wild River Research

SUMMER, 1981

Field Courses, 5 Units

Phone (408) 429-2822 or write:

WILDLANDS RESEARCH INSTITUTE

University of California, Santa Cruz

Santa Cruz, CA 95064



STARSTRUCK?

Stars, moons, planets, and UFOs are pre-cut luminous, and will stick anywhere.



Almost 100 Glowstars can turn your ceiling into a glittering night sky. Only 10 seconds of light sets stars shining. Stars glow for over ½ hour. Glowstars work over and over again—time after time.

Educational and Fun Set up the constellations over your head. Add moons and satellites as discovered. Use rockets and space ships to create your own intergalactic wars.

Twinkling Stars gradually fade as you or your children fall asleep. Rest under your own astrological sign every night.

Free Zodiac Star Chart with each purchase!

Graphicus Design Studio Suite 1716

531 Main St. Roosevelt Island NY 10044

Check or money order enclosed for ____ sets of Glowstars at $4.95 each plus 50¢ postage and handling. NY residents add 8% sales tax. Allow 4 weeks for delivery.

Name _____

Address _____

City _____

State _____ Zip _____

NH020

with each other. As these stars grow, they eventually reach the stage at which they become unstable and explode in supernovae outbursts that supply energy to the galactic nucleus.

The problem with this theory of coalescence by means of collisions is similar to the problem with the theory of disruption due to collisions. As a consequence of developing a concentration of stars sufficient for the necessary collisions to occur, the cluster or part of the cluster would have to shrink into a single supermassive star or a black hole in a period of time shorter than the period necessary to account for the frequency with which the active galactic nucleus is observed.

The conclusion is that dense star clusters may be the precursors of quasars and Seyfert nuclei, but that the phenomenon of actual active galactic nuclei must be related to one of the other two forms of enormous concentrated mass that have been proposed, namely, supermassive stars or black holes.

The mass concentration that was first considered as a possible source of quasar energy was in fact the supermassive star. The relation between the rate of energy emission and the mass of a supermassive star is well known and the power necessary for an average active galactic nucleus could be provided by a supermassive star with a mass of about ten million suns. (If an object of that mass were in the sun's position relative to the earth, its radiant energy would create a temperature of about 50,000° F on the earth.) The most luminous quasars could be powered by a supermassive star with a mass of about 500 million suns. However, a supermassive star of these proportions would not be stable. Calculations show that a supermassive star having a mass of more than about 700,000 suns would collapse irreversibly unless it were rotating so rapidly that it would become flattened and so fractured that it would probably no longer have the characteristics of a star.

Thus, the concentration of mass into a supermassive star capable of powering an active galactic nucleus would apparently almost immediately result in collapse into a black hole. Since a dense star cluster of sufficient mass to power an active galactic nucleus would ultimately produce a supermassive star or a black hole, and since a supermassive star of such proportions would in a very short time col-

Go Wild...

And let Abercrombie & Kent treat you to our twenty years of African Wildlife expertise. We cover the continent—The Nile, Kilimanjaro, Kenya's game parks, Tanzania's Serengeti, The Seychelles, literally from Cairo to the Cape. And we'll put together any type of program—from prepackaged tours to tailormade superdeluxe safaris. Choose minibus, four-wheel drive or wing, lodge or tented camp or any combination.



For further information and brochures contact your travel agent, or

Abercrombie & Kent International, Inc.
Dept. NH1 • 1000 Oak Brook Road
Oak Brook, Illinois 60521
(800) 323-7308 • (312) 887-7766

CHICAGO • NEW YORK • LOS ANGELES
LONDON • NAIROBI • JOHANNESBURG • CAIRO

SEMINARS IN ORNITHOLOGY
The Laboratory of Ornithology at Cornell University Offers a Home Study Course in Bird Biology
Inquire: NH, 159 Sapsucker Woods Road, Ithaca, NY 14850

Share the Thrills of Exploring Outer Space!



$279.95 f.o.b. Hartford, Conn.
$15 Crating Charge

Now it's easy to join the thousands of serious amateurs who have discovered the excitement of exploring our mysterious universe. Your enjoyment begins right from the start, yet the challenges and rewards go on for years! And it's a hobby that can be shared at modest cost.

Choose From Many DYNASCOPES®

Picking a telescope to fit your needs and your pocketbook is simple when you select a DYNASCOPE—the same instruments used by more than 150 schools, colleges and observatories—and your satisfaction is guaranteed by a full-refund warranty.

FASCINATING GUIDE YOURS FREE!

Read these valuable facts before buying any telescope. Mail coupon or postcard for your complimentary copy of this helpful guide.



Criterion Manufacturing Co.
620 Oakwood Ave., W Hartford, Conn 06110

® TM Registered U.S. Pat. Office

CRITERION MANUFACTURING CO., Dept NH 100
620 Oakwood Avenue., W Hartford, Conn 06110
Please send your free Telescope Guide.

Name_____

Address_____

City_____ State_____

No Load's Too Heavy No Chore's Too Tough

for the rugged, amazingly versatile Garden Way Cart!



The Incredible Garden Way Cart!

Yes, handle **HUNDREDS** of tough, time-consuming chores with ease! Our perfectly-balanced, all-purpose Cart lets you wheel BIG, HEAVY loads up to 400 pounds – over rocks, thru mud and even UP hills...with JUST ONE HAND!

That's not all! From hauling away huge loads of leaves, to wheeling trash cans to the curb, this honest-to-goodness WORKSAVER will serve you day in and day out, ALL 4 SEASONS OF THE YEAR!

FREE DETAILS. We'll send you complete details about all 3 Cart Models and show you in actual photos JUST SOME of the amazing things this incredible Cart can do! So mail coupon NOW!

GARDEN WAY RESEARCH, Charlotte, Vermont 05445

Garden Way Research, Dept. A933C
Charlotte, VT 05445

☐ **YES!** Please rush me full, illustrated details about the incredible Garden Carts and include info on low-cost Build-it-Yourself Cart Kits!

Name _____

Address _____

City _____

State _____ Zip _____

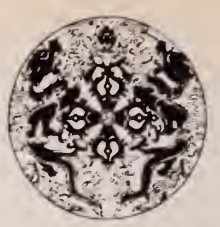
© 1981 Garden Way Inc

lapse to the state of a black hole, many astronomers have argued that black holes are present at the centers of active galactic nuclei. A central, massive black hole could then power these galactic nuclei through the accretion of material from the space between the member stars of the parent galaxy.

The basic idea regarding the accretion process is that material from the galaxy spirals into the central region much as water spirals into a drain. Some theories concerning the growth of black holes picture the material spiraling directly into the hole with each particle releasing as much as 20 percent of its mass energy as it disappears into the hole at nearly the speed of light. Other theories of black hole accretion picture the material accumulating into a disk that rotates around the black hole, with matter leaking into the hole from the inner rim of the disk. In the latter case, energy is generated by material falling onto the disk as well as by material pulled into the black hole.

Some astronomers believe that all spiral galaxies have black holes at their centers and that all galaxies are active to some degree, depending on the rate at which material is pulled by gravity into the black holes. Nevertheless, the inference that the observational properties of quasars and Seyfert nuclei can be entirely explained by a theory involving the presence of black holes should not be made because active galactic nuclei contain some features that are not easily accounted for in terms of black holes. In particular, there are broad emission lines in the spectra of these objects that can be adequately explained in terms of radiation from gas clouds moving radially outward at several thousand miles per second in a manner indicating that the clouds were hurled outward in an explosive event. Massive black holes do not explode and it is difficult to see how an accretion disk could explode because it dissipates, rather than builds up, energy.

Perhaps the quasar and Seyfert nuclei phenomena are not steady, long-term events that occur over periods of as much as 100 million years. Instead, they may be recurring explosive events. In the latter case, black holes cannot be favored over other large concentrations of mass merely because of their long-term stability. In fact, an instability that leads to an explosion might be the necessary property of



Come and journey with us into the Lost Horizon

BHUTAN, HIMALAYAN KINGDOM

Individual & Group tours
guaranteed departures
Contact us or your travel agent

Bhutan Travel Service Dept. NH
133 E. 55th St., NY 10022 – (212) 838-6382

BOOK HUNTING?

Virtually any book located—no matter how old or long out-of-print. Fiction, nonfiction. All authors, subjects. Name the book—we'll find it! (Title alone is sufficient.) Inquire, please. Write: Dept. 71

BOOKS-ON-FILE P.O. BOX 195 UNION CITY, NEW JERSEY 07087

SEA EAGLE
THE TOUGHEST PVC INFLATABLES

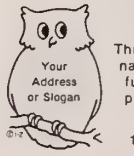
A new series of heavyweight canoes and dinghies $100 – $220
All pack small
All last years



Send for FREE color brochure
Sea Eagle, Dept NH2, St James, NY 11780 • phone 516-724-8900

BOOKS PUBLISHED

National book publisher can print your book for as little as 18¢ per copy (paperback, 100,000 copies). For further info write: Regal Press Inc., 4501 N.E. 36th Street, Oklahoma City, Oklahoma 73121 or call (405) 424-3362.



OWL Stickers

This Sunny Yellow Owl, printed with your name & address or slogan, adds a little fun to letters, books, luggage, toys, promotions.....(shown half size)

Owl Shape...Self-Stick
100 for $6.50 or 200 for $9.20 ppd.

OWLS, Box 735-T, Acton, Mass. 01720

Archeological Expedition

Tunisia

Ancient Carthage, awesome ruins of Imperial Rome, fascinating Islamic fortresses and Saharan Oases. Visit the most fascinating ruins in North Africa. Explore Berber villages, mountain and desert oases. Small escorted groups, expert lectures. Spring and fall departures Write for details.

Society Expeditions
Dept. NH-2
723 Broadway East
Seattle, WA 98102

Name _____

Street _____

City State Zip _____

Please Include: ☐ New Guinea ☐ Patagonia ☐ Easter Island ☐ Galapagos ☐ Mongolia ☐ Tunisia ☐ Antarctica ☐ Amazon ☐ New Guinea & Melanesia ☐ New Guinea & Indonesia ☐ Singapore to Seychelles ☐ Seychelles to Red Sea ☐ Iceland & Greenland ☐ N. & West Africa ☐ China

a large concentration of mass that supplies the energy for active galactic nuclei. Supermassive stars with masses of between about 500,000 suns and masses of about 700,000 suns have just that property. They are unstable, but instead of collapsing into black holes, as do supermassive stars having masses greater than 700,000 suns, they suffer violent nuclear explosions.

In each explosion, enough energy would be released to power a luminous Seyfert galaxy for about 30,000 years. Not all the energy of the explosion would be expected to be converted to radiant energy, but even if only 10 percent were, there would be enough energy to power a Seyfert galaxy for 3,000 years. Since the activity in the nucleus must go on for a total of 100 million years, then 30,000 repetitions of a supermassive star outburst would have to occur. The material at the center of spiral galaxies would have to grow into a supermassive star with a mass of about 500,000 suns in order to cause a violent explosion. Therefore the total amount of material that would have to be processed in order to power a luminous Seyfert galaxy would be equal to the mass of ten billion suns.

A mass of ten billion suns is about 5 percent of the mass of a normal spiral galaxy such as our Milky Way. In order to power a luminous quasar, all the mass of a normal galaxy would have to be processed, a quite unlikely situation.

There are many ifs and maybes, however. Maybe the parent galaxies of quasars are much larger than normal spiral galaxies. Maybe the quasars are not as long-lived as the Seyfert galaxies and don't have to process as much material as it seems. Whatever the case, the mechanism by which the energy of the active nuclei of galaxies is generated is not at this time well understood and our theories regarding the accretion of black holes and the explosions of supermassive stars must be classified as speculation.

Astronomers studying quasars and Seyfert galaxies continue to provide observational data. As these data are analyzed, we hope to come closer to a true understanding of how the nuclei of these objects really work.

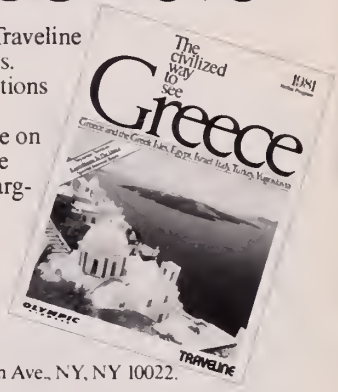
Eugene R. Capriotti is chairman of the Department of Astronomy at Ohio State University and director of the Perkins Observatory of Ohio State and Ohio Wesleyan Universities.

Greece. Our biggest, most civilized book ever.

Other brochures offer slices of Greece. Traveline gives you the whole Greece. Athens. Isles. Cruises. Classical Greece. Plus combinations with Israel, Egypt, Turkey or Italy.

All vacations include *scheduled* service on the No. 1 airline to Greece, Olympic. See your travel agent or Traveline—world's largest designer of tours to Greece.

It's the only civilized way.



TRAVELINE

The civilized way to see Greece.

For free book, mail to Traveline, Inc., 635 Madison Ave., NY, NY 10022.

Name Address

City State Zip Travel Agent

Other offices: Beverly Hills, Falls Church, VA; Hollywood, FL; Ft. Wayne, Toronto, Vancouver, Mexico City, Caracas, Sydney.

NH—Feb.

"A seminal study."*

From the blowhard antagonist of the Three Little Pigs to the foster mother of Romulus and Remus, wolves have long exercised a powerful hold on human imagination. But in the real-life competition between man and wolf, says zoologist Erik Zimen, the wolf's annihilation seems inevitable. "Zimen focuses his attention on the ecology and behavior of the wolf and offers some new insights about aggression and social ranking...Concerned about survival of the species, Zimen gives some practical advice to conservationists. His descriptions of the pack organization and prey-predator relationships are outstanding."—*Publishers Weekly**

With 16 pages of full-color photographs. $13.95



THE **WOLF**

A SPECIES IN DANGER

ERIK ZIMEN

delacorte press

DELL PUBLISHING CO., INC.

SIGN ON WITH SAIL — AND SAVE $6.00 OFF THE NEWSSTAND PRICE

Get a year's subscription, 12 big, colorful, excitement-filled issues for only $18.



No matter what you sail or where you steer her, you'll find more to get excited about in SAIL.

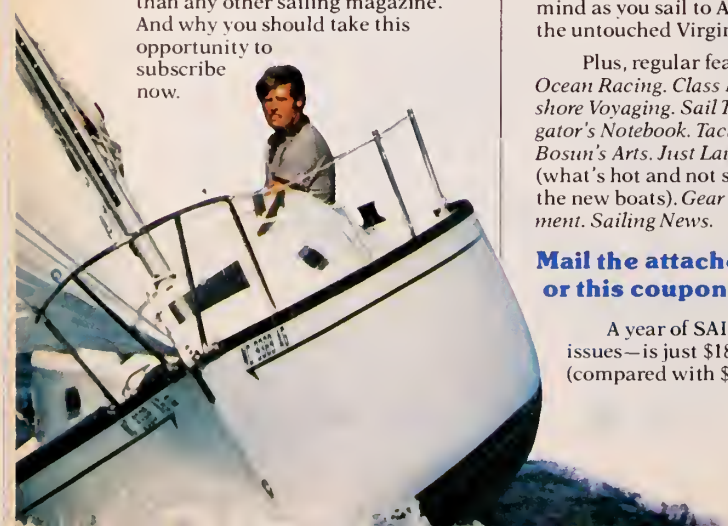
More of the latest seamanship and navigation techniques to help you sharpen your skills.

More of the practical stuff of cruising—both at home and abroad. SAIL's information-packed articles entertain and instruct as they take you to favorite cruising grounds all over North America or to exotic islands abroad.

More firsthand cruising and racing accounts to help you profit from other strategy-wise sailors' experiences.

And more shrewd advice for evaluating new boat and sail designs, equipment, and accessories.

That's why more dedicated sailing enthusiasts read SAIL than any other sailing magazine. And why you should take this opportunity to subscribe now.



SAIL is like getting together with the world's foremost sailing authorities every month

You'll find useful, insightful articles like these in every issue ...with lavish full-color photography that captures the sheer joy of sailing:

FOR SAIL CHEAP
A shrewd look at buying used sails to increase your inventory without sacrificing performance.

SAILING WITH THE DEVIL'S OWN GRIN
In San Francisco Bay, you can pick your weather, but you may have to sail through a runaway washer cycle to reach your breeze.

CROSSBOW MEETS SLINGSHOT
And the world speed record takes another battering, as two of the wildest design innovations in years face off.

CAPTAIN COMPUTER
Maybe a microprocessor will be getting you back on course in the very, very near future.

HOW MUCH DOES SHE REALLY COST?
Why you should take a flashlight and a mirror to find out whether you're getting a bargain or a bad deal.

CRUISING THE LAST VIRGIN ISLAND
Let the trade wind blow your mind as you sail to Anegada—the untouched Virgin.

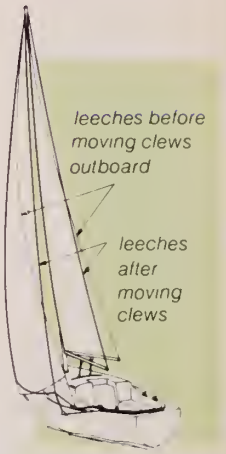
Plus, regular features like *Ocean Racing. Class Boats. Offshore Voyaging. Sail Trim. Navigator's Notebook. Tactics. Design. Bosun's Arts. Just Launched* (what's hot and not so hot about the new boats). *Gear and Equipment. Sailing News.*

Mail the attached card or this coupon today.

A year of SAIL—12 monthly issues—is just $18 by subscription (compared with $24 on the newsstand). And you can start your subscription today without sending us a penny. We'll bill you.

GUARANTEE: If you decide at any time that SAIL is not meeting your needs — for any reason — tell us to cancel and we'll send you a refund for any unmailed issues. No questions asked!

That's how confident we are that America's #1 Sailing Magazine is something you won't want to sail without.





SAIL
Subscription Processing Center
126 Blaine Avenue,
Marion, Ohio 43302

YES! Sign me up for SAIL—12 monthly issues for only $18, a saving of $6 off the cover price. I understand that I may cancel at any time and you will send me a refund for any unmailed issues. DNH4-O

☐ Payment enclosed ☐ Bill me

Name (Please print)

Address

City State Zip

Outside of U.S. and Canada, add $5.00 per year. (Payment must accompany all orders from outside the U.S. and Canada.) Please allow approximately 5-6 weeks for delivery of first issue.

SIGN ON WITH SAIL — AND SAVE $6.00 OFF THE NEWSSTAND PRICE

Get 12 big, colorful, excitement-filled issues for only $18.

YES! Sign me up for SAIL — 12 monthly issues for only $18, a saving of $6 off the cover price. I understand that I may cancel at any time and you will send me a refund for any unmailed issues. DNHC-7

☐ Payment enclosed (Thank you!) ☐ Bill me

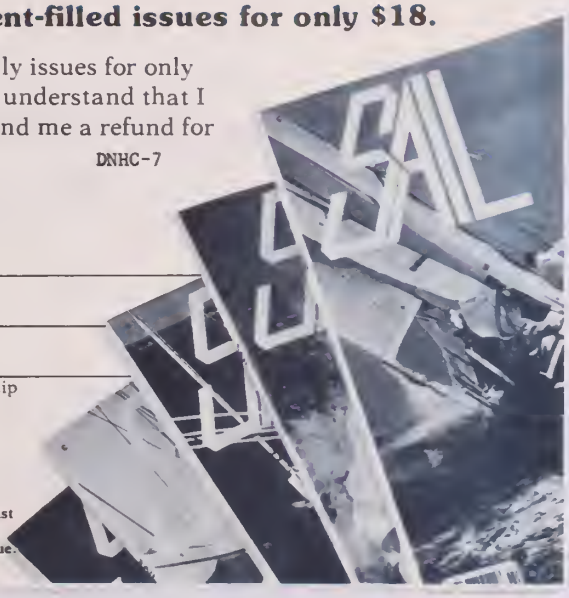
Name (Please print)

Address

City State Zip

Save 25% off the cover price of America's #1 Sailing Magazine. 12 issues for just $18.

Outside of U.S. and Canada, add $5.00 per year. (Payment must accompany all orders from outside the U.S. and Canada.) Please allow approximately 5-6 weeks for delivery of first issue.



NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO. 495 MARION, OHIO

Postage will be paid by

SAIL MAGAZINE
Subscription Processing Center
126 Blaine Avenue
Marion, Ohio 43302

Celestial Events

by Thomas D. Nicholson

The Moon Evening skies are dark and moonless at the beginning of February and March since the moon becomes new early in both months: on the 4th of February and on the 6th of March. The moon first appears as an evening crescent on about February 7, grows to first-quarter on the 11th, and becomes full, filling the night sky, on the 18th. Waning thereafter and entering the morning sky, the moon is at last-quarter on February 26 and ends the month as a waning crescent appearing before dawn. The early crescent appears in the evening again on about March 9 and will be first-quarter on March 12. Perigee moon (nearest the earth) is on the 8th of both February and March, apogee (farthest from the earth) on the 24th of both months. The new moon of February 4 eclipses the sun over the South Pacific Ocean, annular in a narrow path crossing the far southern ocean, partial in a much wider area including Australia, New Zealand, South America, and Antarctica.

Stars and Planets Mercury and Mars are poor evening stars in early February, setting early. On the 17th, Mercury moves into the morning sky, leaving Mars as the only planet east of the sun. Venus, Jupiter, and Saturn are morning stars, but Venus rises too late to be seen. Jupiter and Saturn, on the other hand, rise about two hours after sunset, remain in the sky all night, and set after sunrise. Both planets are moving retrograde through Virgo, to the right of its brightest star, Spica. Jupiter, easily the brighter of the two, passes Saturn from left to right on the 19th, the second event in the triple conjunction involving the two planets this year. The first was in January, the third and last will be in July. The two planets will remain close until then.

The sun moves from the stars of Capricornus into Aquarius in mid-February, Mercury leaves Aquarius and shifts to the west (retrograde) into Capricornus, while Venus moves into Capricornus from Sagittarius. There are three planets in Virgo—Jupiter, Saturn, and Pluto. Uranus is in Libra, on the border of Scorpius, and Neptune is in Ophiucus.

February 1: Mercury is at greatest easterly elongation for a week or so before and after this date, placing it in position to be seen as an evening star, low in the west about 45 minutes after sundown.

February 5: The early crescent moon covers Mars (an occultation) today over the Southern Hemisphere. They set too early this evening to be seen.

February 7: Mercury begins retrograde (westerly) motion.

February 10: Mercury and Mars (both setting soon after sundown) are in conjunction. They (like Jupiter and Saturn) also are going through a triple conjunction: the first was in January, this is number two (the "retrograde" conjunction), and the third will be in April.

February 12–13: The star near the moon after sunset is Aldebaran, in Taurus. The moon occults the star before sunset.

February 17: Mercury passes the sun from left to right (inferior conjunction).

February 18–19: Jupiter passes Saturn, the second event in their triple conjunction. Jupiter (the brighter of the two) now moves to Saturn's right, but very slowly.

February 21–22: Be sure to look for the gibbous moon and nearby Jupiter and Saturn, rising about 2½ hours after sundown. The moon passes both planets before sunset, moving slowly away to their left during the night.

March 1: Mercury resumes its direct (easterly) motion as a morning star.

March 4: Mercury is near the waning crescent moon during the early dawn, rising about an hour before sunrise.

March 11: The moon is near Aldebaran again, occulting the star at about 11:00 P.M. EST over northern Canada.

March 15: Mercury, at greatest westerly elongation (to the sun's right), may be seen as a morning star for a week or so before and after this date, but it is quite low in the east even at sunrise.



Mars as seen by the Viking Lander 1 NASA

THE MARKET

Art

BRITISH BRASS RUBBINGS. Portraits of the English nobility of the past. Rubbings of old monumental church brasses. Individually handmade. Illustrated catalogue $1 (refundable first order). Godolphin, 6910 E. Mesa Grande Drive, Tucson, AZ 85715

EXCITING LASER PICTURES. Beautiful Framed Pictures of wildlife and scenic photos reproduced by quality Laser technology. Must see to appreciate lifelike color and clarity. Send $1.00 for color catalogue to Impact, 125J Mason Cir., Concord, CA 94520

IROQUOIS SMALLPOX FALSE FACE, $85, request photo; hand made colonial style Whimmy Diddle, $5.00, McCoy Imports, Liberty NY 12754

OUR NATIONAL PARKS IN FULL COLOR. Free illustrated brochure of large lithographs splendid for framing. Write Photo Classics, Box 11, Dickerson, MD 20753

THE FLYING EAGLE®: The ultimate Bald Eagle photograph. Acclaims by "Alaska" Magazine & "Audubon." Bird gliding gracefully at me against brilliant blue sky, looking me directly in the eye, beak open talking to me. 16 × 20 fine art print, $15. Deluxe greeting cards, European quality panoramic postcards, ultra-quality stationery. Sample correspondence packet, $2. Ken Hunter, Egegik, Alaska 99579

WILDLIFE PRINTS by Eckleberry, Hagerbaumer, Ruthven. About $300. Harlan Hamilton, 170 E. 83rd Street, NYC 10028 (212) 535-5690



Back Numbers

NATIONAL GEOGRAPHICS, 1888 - 1980, Issues, Book Publications, Collectors Items. Send Wants. Buxbaum Geographics, Box 465-NH, Wilmington, DE 19899

Book Publishers

PUBLISH YOUR BOOK! Join our successful authors. Publicity, advertising, beautiful books. All subjects invited. Send for fact-filled booklet and free manuscript report. Carlton Press, Dept. NHB, 84 Fifth Avenue, New York 10011

Books

BECOME A SPARETIME TRAVEL AGENT, detailed guidebook explains how, commissions, travel benefits, $3.95, SAV Travel, Box 571-NH, Hicksville, NY 11802

BOOKFINDING. Librarians search worldwide titles or subjects plus 150,000 indexed stock. PAB, 2918 Atlantic, Atlantic City, NJ 08401 (609) 344-1943

OUT-OF-PRINT, SCARCE, Zoology, Botany, Ornithology, Colorplate, etc. Catalogue $1. Book Chest, 19 Oxford Place, Rockville Centre, NY 11570

PUBLISHERS' OVERSTOCKS, BARGAIN BOOKS. 2,000 titles, all subjects! Free catalogue. Hamilton, 98-55 Clapboard, Danbury, CT 06810

RIVER LORE—Reprints of early 19th century books describing history and geography of the Mississippi, Ohio and Missouri Rivers with maps, pictures and sketches. Send for free brochure. Howard Creek Galleries, Box 24115, Cincinnati, OH 49224

SOUTH AMERICA BOUND? We've got detailed guidebooks, maps for travellers. Europe, Asia too. Send for free catalogue. Bradt Enterprises, 54-N Dudley, Cambridge, MA 02140

TEACH YOURSELF STAINED GLASS, send $10 for 2 volumes to Stained Glass Primer, Dept. SGN, 10033 Broadway Terrace, Oakland, CA 94611

WILDLIFE, BIRD REPTILE BOOKS, selected worldwide publications. Large descriptive catalogue 50¢. Zoo Books, Box 3, Hollywood, FL 33020

YESTERDAY'S BOOKS LOCATED, no obligation. Out-of-State Book Service, Box 3253J, San Clemente, CA 92672 (714) 492-2976

Camps

NATURAL SCIENCE CAMP in Ontario. . . Co-ed, ages 9-14. Serious nature study plus wilderness canoe tripping. Banding birds, collecting minerals, investigating marshes plus swimming and canoeing instruction. Small informal groups. Blue Heron, Box NH, 511 Morris Place, Shillington, PA 19607

PRAIRIE TREK (Boys 13-17)—Turquoise Trail (Girls 13-17)—Little Outfit (Boys 10-12). Since 1926 these expeditions have made it possible for young people to explore in the mountains, canyons, and desert country of the American Southwest. Emphasis on environmental studies, archaeology, native crafts, backpacking and camping skills. For details write: Thomas M. Billings, P.O. Box 40451NH, Indianapolis, IN 46240 (317) 896-3842

Collectors' Items

BEAUTIFUL CRYSTALLIZED MINERALS from India, South America, Europe, Mexico and the United States. Browse the largest and most varied collection of exciting specimens in New York City. Crystal Resources, 130¼ East 65th Street, New York City. Hours 1-6:30pm Mon-Sat (except Wed)

PRESS PHOTOGRAPHS—Over 1,000,000 vintage photos covering nine decades. Priced from $5 to $200. Details: Underwood Photo Archives, Ltd. 3034 Steiner St., San Francisco, CA 94123 (415) 567-6141. (Sole agent for the sale of photographs from the Underwood & Underwood News Photo Archives).

RECEIVE VALUABLE MINERALS MONTHLY! Write today! Free Details! Mineral of the Month Club, 13057-H21 California, Yucaipa, CA 92399

Correspondence

MAKE FRIENDS WORLDWIDE through international correspondence. Illustrated brochure free! Hermes-Verlag, Box 110660/NH, D-1000 Berlin 11, West Germany

ORIENTAL WOMEN SEEK CORRESPONDENCE for cultural exchange, language practice, friendship. Asian Exchange, Honokaa, Hawaii 96727

Education

NONRESIDENTIAL UNIVERSITY DEGREES

Bachelors, Masters, Doctorates, for the accomplished individual. State-authorized, inexpensive, efficient. *Richard L. Crews, M.D., President*

COLUMBIA PACIFIC UNIVERSITY
150 Shoreline, Suite 8402 • Mill Valley, CA 94941
Call Toll Free USA: 800-227-1617, ext.480
California Only: 800-772-3545, ext. 480

FIRST TIME OFFER. How to separate gemstones from imitations and substitutes. Fascinating. Instructions supplied. Prepared by Certified Gemologist. Send $3.00 Joel Lynne, P.O. Box 312, 6141 Saunders Street, Rego Park, NY 11374

MAINE ISLAND ECOLOGY. Marine biology, botany and ornithology on 200 acre island. Exciting opportunity for high school students interested in environmental studies. Faculty-student ratio 1:5. Over 10 years of operation. From June 26 to July 14 or July 18 to August 5. Contact Maine Island Ecology, Academy of Natural Sciences, Nineteenth and the Parkway, Philadelphia, PA 19103

Employment Opportunities

AUSTRALIA NEEDS YOU! Jobs! Paid Transportation! Newest handbook, $2.00 (guaranteed). Australian International Services, Box 19107-RN, Washington, DC 20036

AUSTRALIA—NEW ZEALAND NEED YOU! Big Pay! 50,000 jobs. Free transportation. Latest listings $2.00. Austco, Box 772, Cypress, CA 90630

AUSTRALIA . . . NEW ZEALAND WANT YOU! 17,500 Jobs! Paid Transportation! New Report! $2—Moneyback Guarantee! "Australia Commission," Department 894-C2, National Press Building, Washington, D.C. 20045

FREE DETAILS—OVERSEAS JOBS! All occupations! 68 countries. Paid fare. Computerized reports. Jobworld, Box 681, Cypress, CA 90630

JOBS OVERSEAS . . . (Including Alaska Gas Pipeline). Free Details. Global Employment, Box 808-NH, National City, CA 92050

OVERSEAS—ALL OCCUPATIONS! Worldwide Directory and complete information—$3.00. International Opportunities, Box 19107-RN, Washington, DC 20036

ROCKY MOUNTAIN EMPLOYMENT NEWSLETTER! Colorado, Idaho, Montana, Wyoming! Current openings—all occupations! Free details . . . Intermountain-4Y, 3506 Birch, Cheyenne, WY 82001

TEACHERS - ADMINISTRATORS: School, college job openings: USA, $5.95; Abroad, $5.95. Placement, sources USA, $4.95; Abroad, $4.95. EISF, Box 662, Newton, Massachusetts 02181

Financial

GET CASH GRANTS—from Government. (Never repay.) Also, cash loans available. All ages eligible. Complete information, $2 (refundable). Surplus Funds-NH, 1629 K St., Washington, D.C. 20006

Foreign Newspapers

WORLDWIDE ENGLISH NEWSPAPERS. 65 countries including Greece! Sampler: 5/$2.98. Free Brochure. Multinewspapers, Box DE-202, Dana Point, CA 92629

Gourmet Interests

FAST GOURMET FROM HAWAII. 400 pages. $14.95. "Gourmet Gau Gee and Vegetables on Noodles." $1 recipe. Pi, Box 23371, Honolulu, Hawaii 96822

MAKE ZESTY WINE VINEGARS! Directions, self-perpetuating culture, $3.00, SASE. Home Vinegars, Box 15625, Seattle, WA 98115

SUPERB, UNUSUAL, HAWAIIAN RECIPES. Chicken, Lobster Tails, Pork Chops. $1 each, 3/$2. SASE, I. Jeffries, 160 East 38th Street, NY, NY 10016

Government Surplus

"GOVERNMENT SURPLUS DIRECTORY." Buy 500,000 items (including Jeeps) . . . low as 2¢ on dollar! Most complete information available-$2.00. Surplus Disposal, Box 19107-RN, Washington, DC 20036

SURPLUS JEEPS—$19.30!—CARS—$13.50!—650,000 Items!—Government Surplus—Most Comprehensive Directory Available Tells How, Where To Buy—Your Area—$2—Moneyback Guarantee—"Government Information Services," Dept. DC-2, Box 99249, San Francisco, CA 94109

Merchandise

BELTS BY A TIPPIT! Four 1¼" cotton web belts with brass plated buckle, packed in their own canvas travel bag. Change the belt—Change the buckle! In Navy, Red, Khaki and Brown. To receive belts postpaid, send check or money order for $16.95 to A Tippit, P.O. Box 16554, Fort Worth, TX 76133 (817) 355-2087 (Texas residents add 85¢ sales tax)

FREE CATALOGUE. Distinctive merchandise for discriminating people. We have Wildlife Prints by the renowned James Lockhart, Austrian backscrubbers, Peoplefeeders, Norwegian Footwear Dryers, Admirals Lamps, things for the den, more. The Armchair Emporium Ltd., 825 Surrey Lane, Dept. NH1, Algonquin, IL 60102

GREENHOUSES, prefabricated, redwood and fiberglass. Guaranteed. Free Brochure, Gothic Arch Greenhouses, P.O. Box 1564-NH, Mobile, AL 36633 (205) 432-7529

HANDMADE GLYCERINE NORTH COUNTRY SOAP, wrapped in quilting calico. Wooden crates hold 3 large soaps. $6.50. Dealers Inquire. 7888N Cty 6, Mapleplain, MN 55359

"I LIKE IT WILD℠ . . ." Wilderness/wildlife posters, T-shirts, notecards. Send stamped envelope: Wilderness Dreams℠, Box 4455-N, Shawnee Mission, KS 66204

PURCHASE BOWIE, Civil War knives, Indian tomahawks. Robert Abels, 2881 N.E. 33 Court, Fort Lauderdale, FL 33306

Plants/Seeds

UNIQUE SEED CATALOGUE, a practical growing-use guide to over 150 varieties; Herbs, Medicinals, Insect Repellent Useful Plants $1.00. Catalogue plus 4 seed pkts. Balm, Camomille, Peppermint, Pennyroyal $3.00. Naturalist, P.O. Box 435-N3 Yorktown Heights, NY 10598

Photo/Optical

BINOCULAR SALES AND SERVICE. Repairing binoculars since 1923. Alignment performed on our U.S. Navy collimator. Free catalogue and our article "Know Your Binoculars," published in Audubon Magazine. Mirakel Optical Co., Inc., 331 Mansion St., West Coxsackie, NY 12192 (518) 731-2610

Real Estate

FREE! Big Spring Catalogue! Over 5,400 country properties described, pictured! Land, Farms, Homes, Businesses, Recreation, Retirement buys! Selected best thruout the U.S. Over 700 offices, 43 states All Across America! Yours Free from the World's Largest! Strout Realty, Inc., 60 E. 42nd Street, Dept. 5390, New York, NY 10017

FREE . . . 296-PAGE CATALOGUE. Describes and pictures over 2,800 farms, ranches, acreages, businesses and town and country homes from coast to coast. United Farm Agency, Inc., 612-V W. 47th St., Kansas City, MO 64112. Ph. Toll-Free: 1-800-821-2599; MO. Res. Ph. Toll-Free: 1-800-892-5785

GOVERNMENT LANDS . . . FROM $7.50/ACRE! Homesites, farming, vacationing, investment opportunities! "Government Land Buyer's Guide" plus nationwide listings—$2.00. Surplus Lands, Box 19107-RN, Washington, DC 20036

LIQUIDATION MICHIGAN LAKE living property, Lost Lake, Roger City area wooded, fishing, 100 × 200 foot lots only $3,995. Nothing down, only $39.00 month. Other properties available. Phone free 1-800-521-4996, Michigan 1-800-482-4974. Write NJ Lake, 3650 Dixie, Drayton Plains, Michigan 48020

SURPLUS LAND FROM $3.50/ACRE!—New Buyer's Guide shows how!—Vacation!—Investment!—$2 Moneyback guarantee! "Surplus Lands Bureau" 894-E2 National Press Building, Washington, DC 20045

Recordings

OLD TIME RADIO PROGRAMS on cassette tapes. Free catalogue. Cassette Library Center, P.O. Box 5331H, Baltimore, MD 21209

RECORDS—TAPES! Discounts to 73%; all labels; no purchase obligations; newsletter; discount divident certificates; 100% guarantees. Free details. Discount Music Club, 650 Main St., Dept. 25-0281, New Rochelle, NY 10801

Rentals

ADIRONDACK LODGES on Upper Saranac Lake. Available for two weeks or a month, July through September. Everything provided for comfortable living in the quiet woods. From $650–$1,700 for two weeks. Please write Bartlett Carry Club, RFD 3, Tupper Lake, NY

ST. JOHN, VIRGIN ISLANDS vacation apartment for two. Near beaches for snorkeling and National Park for exploring. $275 weekly. Barsel, Box 114, St. John, U.S.V.I. 00830

Resorts

LITTLE ST. SIMONS ISLAND

One of Georgia's "Golden Isles"



Birding, beachcombing, riding, wildlife photography, fishing or just relaxing on a secluded 12,000 acre island with miles of unspoiled ocean beaches, forests and marshes. Over 200 species of birds. Maximum of 10-15 guests at a time. Excellent food and accommodations. Professional naturalists on the staff. **Little St. Simons Island** P.O. Box 1096N, St. Simons Island, GA 31522

BELIZE—RUM POINT INN, Placencia. Personalized vacation maximum 8; snorkle largest reef in hemisphere; visit unfrequented Mayan Ruins; experience other cultures while enjoying private seaside cabins, interesting cuisine. Write 3526 Old Onslow Road, Greensboro, NC 27407

KIAWAH ISLAND: Near Historic Charleston. Exclusive resort rentals of private homes and villas. Call 1-800-845-3911. (In S.C. 1-571-0214). Tidelands Realty, Inc., P.O. Box 30067, Charleston, SC 29407

NEW MEXICO. Guided tours—wildflowers, birds, prehistoric dwellings. Bear Mountain Ranch, Silver City, NM 88061 (505) 538-2538

SKIFFLES VILLAS, Anquilla, West Indies, unspoiled island, pool, beautiful beaches, luxurious, (219) 533-0461, 614 East Purl Street, Goshen, IN 46526

VACATION/RELAXATION—Birdwatcher's delight—Peaceful, secluded nature lover's mountain retreat. Cave Creek Ranch, Portal, Arizona 85632

Tours/Trips

ADVENTURES—Observe whales in Baja Lagoons and off Maui, Hawaii. Photograph Polar Bears & Beluga Whales in Canadian Arctic. Wildlife adventures to South America, Galapagos, Kenya, Tanzania, Zambia & Zaire. Expeditions to New Zealand, Australia and the Himalayas. 1981 trip preview available. Adventures International, 4421N Albert, Oakland, CA 94619

AFRICA: AN EVOLUTIONARY SAFARI—Explores the game parks and sites of human origins in Kenya 7/25-8/21/81. $2150 land costs. Contact: Wilderness Programs, Box N, University Extension, UC Davis, CA 95616 or phone (916) 752-3098

AFRICAN WILDLIFE SAFARIS. Special expeditions. Small groups—Private camping in "Wild Africa." For details write to: The Dee-Barry Company, 4130 Timber Lane, Philadelphia, PA 19144

ALASKA TRAVEL ADVENTURES—Explore Alaska in guided small group trips. Backpacking, canoeing, kayaking, whitewater rafting, wildlife photography, fishing, custom trips, Alaska-Hawaii combinations. Free catalogue describes 50 different trips throughout Alaska for all ages and abilities. Contact Alaska Travel Adventures, 499 Hamilton, Suite 212U, Palo Alto, CA 94301. In California call collect (415) 329-9013, elsewhere toll free (800) 227-8480

ALASKAN WATER ADVENTURES. Kayaking, Rafting, Birding in Prince William Sound and Copper River Basin. Open Door, Box 1185N, Cordova, Alaska 99574 (907) 424-7466



ANDES TREKKING: Cordillera Blanca and Inca Trail, Peru. Amazon wildlife extension. Three weeks, July. $995.00. McGregor Adventures, 33-N Lewis Street, Greenwich, CT 06830. Toll Free (800) 243-5330

Discover The YUKON! **A "Gentle Adventure"**

An unforgettable wilderness sojourn guided by John Lammers, seasoned naturalist and long time Yukon dweller; designed for 3-6 discerning people.

River, Mountain, Float & Fly-In Trips. Call for brochure (212) 682-0480(NYC) or write: Yukon Wilderness Unlimited, P.O. Box 4126, Whitehorse, Yukon, Canada.

CANOE ARCTIC. Fly-in canoe expeditions into the heart of North America's last great wilderness—the tundra and taiga of Canada's Northwest Territories. Discover the warm dry summers, spectacular scenery, and unparalleled wildlife concentrations of a land untouched by man. Photograph caribou herds, white wolves, muskox, moose, grizzlies, rich birdlife. Virgin fishing. Groups of 6 or 8 persons assembled and guided by Alex Hall, wildlife biologist and veteran arctic canoeing guide. All food and equipment provided. Can accommodate a limited number with no previous canoeing experience. Two-way radio. 12 days from $1210; 18 days from $1570. For brochure write: Canoe Arctic Inc., Box 130(C), Fort Smith, N.W.T., Canada XOE OPO

CANOE TRIPS IN WILDERNESS NOVA SCOTIA, July-September. Small groups with licensed guides. Excellent food. Write: Granville Nickerson, RR#4N, Annapolis Royal, Nova Scotia, Canada BOS 1AO

COSTA RICA NATURE TOUR, Birding & Botany, June 1981. Contact: Far West Travel, 3000 Ocean Park Boulevard, #1008, Santa Monica, CA 90405, tel: (213) 450-3040

GALAPAGOS/ECUADOR/PERU. Two natural history tours with expert leaders include one week cruising the Galapagos on small sailboats. "Peru & The Galapagos" includes Lima, Cuzco and Machu Picchu, 19 days departing March and June. "Ecuador Nature Expedition" includes Amazon jungle, Andes and Galapagos, 23 days departing July, August and November. Write: Wilderness Travel (formerly South American Wilderness Adventures), 1760-NG Solano Avenue, Berkeley, CA 94707

HIKE THE SWISS ALPS. Swissair flies you to special hiking tours, led by popular author/mountaineer Fred Jacobson. Zermatt, Saas-Fee, Lenk, Kandersteg, Pontresina. Beautiful and challenging trails. Delightful country inns. Superb cuisine. 9th summer! Write Fred Jacobson, Depth. NH2, Chappaqua Travel, 24 S. Greeley Avenue, Chappaqua, NY 10514

HIMALAYAN ADVENTURE TREKS—Rammel Expeditions, Box 183, Tetonia, Idaho 83452. Enthusiastic Rammel trekkers will describe our quality trips on request. Write for reference list and information.

HIMALAYAN TRAVEL, INC. Trekking expeditions in the Everest and Annapurna areas of Nepal. Exotic cultures/spectacular mountain scenery. Box 481-NH, Greenwich, CT 06830 Toll Free (800) 243-5330

LEGENDARY CULTURES/FASCINATING NATURE. Special Programs to Latin America and Africa. Forum Travel, 2437 Durant, Berkeley, CA 94704 (415) 843-8294

MEXICAN & CENTRAL EXPEDITIONS by Wayne Hussing, 11120 Raphel Road, Upper Falls, MD 21156 (301) 592-7247—White water Rafting—Volcanic Climbs—Backpacking—Jungle Exploration—Overland Drives, Oct-July

NATURALIST GUIDED FIELD SEMINARS and tours, West Texas and Mexico. Rafting, hiking, backpacking, bus. University or Continuing Education credit as appropriate. Write Education Department, Chihuahuan Desert Research Institute, Box 1334, Alpine, TX 79830

NATURE PHOTOGRAPHY field work and instruction: adventure vacations to remote areas throughout the West. Rafting, horsepacking and hiking with professional guide/instructors. Write for brochure: The Natural Image, P.O. Box 45, Winthrop, WA 98862

NATURE TOURS emphasizing birds, wildflowers, mammals. Small groups to Central, South America, Galapagos, China, Western America, Britain, Kenya, New Guinea, Australia, and more. Write for brochure. World Nature Tours, Box 693a, Silver Spring, MD 20901

ORIENTAL ECLIPSE EXPRESS. China—Mongolia—Siberia. Hong Kong, Nanking, Sian, Peking, Ulan Bator, Lake Baikal, Irkutsk, and Bratsk. View 31 July 1981 Solar Eclipse. 21 days-$3595. Baylis-Todd Eclipse Tour, Claremont Hotel, Berkeley, CA 94705 (415) 849-4333

PERU: Unusual sites and scenes. Includes pre-Inca cultures, two nights in Machu Picchu. Forum Travel, Dept. NH, 2437 Durant, Suite 208, Berkeley, CA 94704 (415) 843-8294

SAIL PRINCE WILLIAM SOUND: Guided flotilla cruises. Lessons available. Whale observation. Nature Study. College credit. Alaskan Wilderness Sailing Safaris, Box 701N, Whittier, Alaska 99693 (907) 277-0160

SCOTLAND, ORKNEY, SHETLAND AND ICELAND. Comprehensive program of nature trips. Write: Caledonian Wildlife at McGregor Travel, 33 Lewis Street, Greenwich, CT 06830, or toll-free: (800) 243-5330

SMOKY MOUNTAIN FIELD SCHOOL. Intensive 5-day and 2-day field workshops in the Great Smoky Mountains National Park. Includes Wild Mammals, Birds, Natural History, and many more. Co-sponsored by Smoky Mountains National Park and University of Tennessee Continuing Education Division, 2016 Lake Avenue, Knoxville, TN 37916 (615) 974-6688

TRAVELEARN, SUMMER 1981. Cultural-natural historical tours to Africa, Hawaii, China, and Greece led by specialists in the fields of study encompassed within each program. Office of International Studies, Kean College of NJ, Morris Avenue, Union, NJ 07083 —Phone (201) 527-2461

WASHINGTON WILDFLOWER SAFARIS to Cascades and Olympics with professional naturalist. Brad's Tours, 401 E. Mercer #31D, Seattle, WA 98102

WILDERNESS ALASKA. Cruise among eagles, whales, glaciers and fiords, Arctic Tramp, Box 827, Valdez, AK 99686

WILDERNESS TRAILS IDAHO. Backpacking, Ski-touring, and Bicycle-touring. Come adventure and learn with us. Trips for all abilities, everything provided. We have thirteen years experience and guide only in Idaho. Write: P.O. 9252 M, Moscow, Idaho 83843 (208) 882-1955

RATES AND STYLE INFORMATION

$1.75 per word; 16 word ($28) minimum. *Display classified* is $150 per inch. All advertisements must be prepaid. Rates are not structured for agency or frequency discounts. All advertisements are accepted at NATURAL HISTORY's discretion. Send check/money order payable to NATURAL HISTORY to: The Market, NATURAL HISTORY Magazine, Central Park West at 79th St., New York, NY 10024. Please include your personal address and telephone number, issue preferred, and suggested heading. Deadline—8th of month, two months prior to cover date (the January issue closes Nov. 8). Camera-ready art is required for display ads. A tearsheet or copy of the page with your ad will be sent upon publication.

High Living

by Victor B. Scheffer

ABOVE TIMBERLINE, by Dwight Smith. *Alfred A. Knopf, $13.95; 288 pp., illus.*

It was the kind of assignment many a biologist would jump at. Find a remote place near timberline in a scenic region of the Rockies, a place where you will camp alone from spring to early winter. Set up camera stations from which you will photograph seasonal changes in (1) a pond surrounded by willows, (2) an alpine bog, (3) the edge of a snowfield destined to be bared in summer as a meadow, and (4) a krummholz, or dwarf forest, at timberline. Collect plants and identify them. Record in motion pictures the behavior of high-country birds and mammals. Make friends with the gray jays, nutcrackers, chipmunks, martens, and other camp followers that will visit you.

Plan daily to record your thoughts on tape. Tell what new insights into nature's mysteries you have gained. Describe red dawns, lightning crashing on the peaks, and the soft shapes of new snow. Tell also of changes in your personal outlook on life, for changes will surely steal upon you after months of immersion in a sphere that will seldom echo any human voice but your own. You're apt to learn as much about yourself as about the mountain. Try your best to *enter* your environment . . . but for God's sake be careful!

So Dwight Smith, age fifty, a professor of wildlife management and ecology at Colorado State University, accepted the assignment. He started on snowshoes in June and ended on snowshoes in November. He camped in a deserted gold miner's cabin at an elevation of 11,740 feet, ninety miles southwest of Denver. Enduring painful bouts of bursitis, he cheerfully hiked for miles in the thin alpine air, often carrying a 65-pound pack.

We learn from words that he dictated in the quiet of his cabin that he came from a poor family; worked hard as a farmer, truck driver, mule skinner, logger, and soldier; converted to his wife's religion (Catholicism) twenty-five years after marriage; was 49 before he managed to earn his Ph.D. He's still a workaholic. Although he no longer hunts for sport, he acknowledges the historic contribution made to wildlife conservation by sport hunters and their expenditures.

This book is the fourth in a series conceived by Alan Landsburg Productions of Los Angeles. The idea of the series is "to immerse a biologist in a natural environment for an extended period, alone, far from any laboratory or highway." Three earlier books dealt with an Alaskan lake, a Costa Rican rain forest, and a Pacific atoll.

The setting of the story is one that Zane Grey would have called forbidding—a place of drying winds, intense sunlight and ultraviolet radiation, Saint Elmo's fire, inch-thick hailstones, and avalanches. Living at timberline on the Continental Divide is not easy for Smith. As late as July 24 the ground around his cabin is often covered with frost in the morning, and he feeds two woodstoves in the evening to keep warm. By September 18 summer is over, the thermometer reads six degrees above zero, and Smith is sleeping under seven army blankets. His visits to a doorless outhouse, the seat of which may be white with frost or drifted snow, are as infrequent and swift as possible.

The plants and animals that live at timberline are said by poets to brave the elements, but in fact this is their *place;* they are adapted to it. When, experimentally, they are moved to lower and milder regions, they suffer from competition with native species and from diseases that they have never "learned" genetically to oppose. The only annual plant near Smith's camp is a tiny buckwheat (*Koenigia*). The rest are perennials that bloom quickly in the alpine summer, then pump nutrients into their roots for cold storage during the winter. The champion at survival among the subalpine animals is the pika, a small, rabbitlike creature that cuts hay, dries it in the sun, and caches it under rock slides against the long, dark months ahead.

Now and then I detect educational overtones (not displeasing) in the author's voice—especially when he drifts away from his narrative to reveal some secret of animal behavior.

"The coyote," he explains, "is one of the few large predators to have expanded its range since the advent of civilization." Of the porcupine: "This lumbering creature is one of the most astonishing animals. Any animal willing to carry, lifelong, a prickly armor of some 30,000 barbed quills so that it may peacefully eat tree bark deserves some respect." He reports that a community of gophers can move four to eight tons of soil per acre per year. Of the pikas: "To obtain maximum value from their food [they] regest their own fecal matter, which is high in protein and energy value. They preserve body moisture by depositing almost crystalline urine, which leaves the white nitrogenous salt deposits often seen by hikers here on boulder surfaces." White-tailed ptarmigans, he notes, "are so successful in blending with their environment, and so confident of their invisibility, that it is possible to step on a nesting bird without seeing it."

I'm pleased to read Smith's opinion as to the economic status of pocket gophers on the western range for it happens to coincide with mine. I was studying gophers in Colorado in the 1950s when the "burrow builder" was invented. This is a sort of plow that digs a tunnel (an open invitation to gophers) into which poison baits are subsequently inserted. However, Smith tells us, "there is no conclusive evidence that [gophers] harm our economic interest, let alone the environment in a more general sense."

"What I am suggesting," he continues,

> is that everything in this universe has its place, and every time we diminish or destroy one species we tamper with a complex and delicate system that we know very little about. When the Rolls-Royce company sells an automobile, it comes with a locked hood so the owner won't fool around with the engine. We humans have been given a Rolls-Royce with an unlocked hood and we are tinkering around with machinery we understand poorly.

After a month on the mountain Smith realizes that, constrained as he is by lack of scientific equipment and by lack of free time after working at personal survival, he can hardly do any real research. His mission comes into focus as one simply to produce "a rather human story of a scientifically trained man who lives more or less alone in the wilds for a few months, observing and thinking about the environment he is living in." The result is a book that both educates



For centuries man feared it, made sacrifices to it, wailed over it. Now we run to greet it. You are extended a unique invitation to witness one of nature's most awesome spectacles, a total eclipse of the sun. On July 31, 1981 the British cruise ship, m.s. Coral Princess will be positioned 1000 miles off the coast of Japan to rendezvous with eclipse totality.

The ORIENT ECLIPSE CRUISE and expedition is the sequel to the six previous historic VOYAGE TO DARKNESS eclipse expeditions which successfully intercepted totality off the coasts of Nova Scotia, Africa, the Caribbean, in the Pacific and at Montana's Big Sky eclipse expedition.

The ORIENT ECLIPSE CRUISE adventure offers a distinguished staff of shipboard lecturers (including meteorologist Dr. Edward M. Brooks) scientific, cultural and educational programs, and tours of Japan, Hong Kong, Macau and China.

Join us as we probe earth, sea and space for yet another exciting and memorable cosmic adventure as we sail into totality and beyond.



ORIENT ECLIPSE CRUISE

Voyage to Darkness VII

NH

Orient Eclipse Cruises, Inc.
1080 Fifth Avenue
New York, N.Y. 10028

Please send me more information on the ORIENT ECLIPSE CRUISE

Name _____

Address _____

City _____

State _____ Zip _____

Light up your life!

CHART ROOM SWIVEL LAMP OF GLEAMING SOLID BRASS



Designed originally for use in ships' chart rooms... now a handsome and handy addition to your home!

Perfect for reading, studying, sewing, crafts, hobbies and all close work

only $64.00 *Sight-Saver Special 2 for $119.00*

This solid brass lamp is a "sight for sore eyes" in two ways. First, its traditional nautical look and efficient design give it a unique, functional beauty that blends well with every decor. Second, and most importantly, it helps eliminate eye-strain with a four-direction swivel feature that puts the light precisely where it's needed. It mounts on the wall, reaches 25" into the dark and can accommodate a high-wattage bulb. Wonderful in any (or every) room of the house... doubly handsome and practical used in pairs to flank a bed or sofa! (Z803585), **$64.00 ea., 2 for $119.00**

OUR GUARANTEE
If you are not completely pleased with your purchase, return it any time for a full, prompt, no-questions-asked refund.

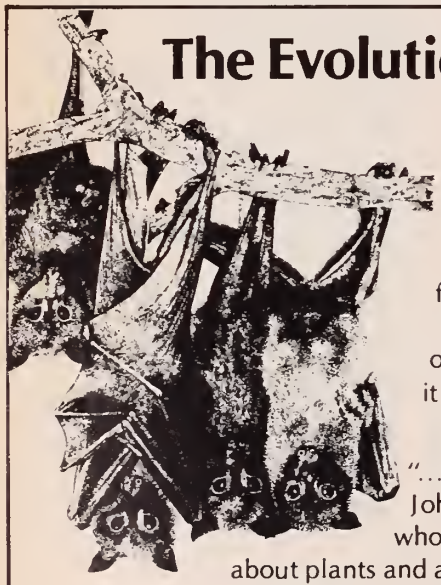
PENNSYLVANIA STATION
340 Poplar St., Hanover, Pa. 17331

PENNSYLVANIA STATION, Dept. PZ-8619 340 Poplar Street, Hanover, Pa. 17331

Please rush _____ Solid Brass Swivel Lamp(s) (Z803585) for just $64.00 ea. plus $2.50 shipping & handling.
☐ SAVE! Order 2 for $119.00 plus $4.00 shpg. & hdlg.
CHARGE IT: ☐ American Express ☐ Diners Club ☐ Carte Blanche ☐ Visa ☐ Master Charge
Acc't. no._____ Exp. date_____
☐ Enclosed is $_____ (check or money order)
(Pa. residents please add sales tax.)

PRINT NAME _____
ADDRESS _____
CITY_____ STATE_____ ZIP_____
☐ Check here and send 50¢ for year's subscription to our catalog of fine gifts and fashions (Z801209X). We ship within 48 hours; delays notified promptly. Delivery guaranteed within 60 days.

© Pennsylvania Station, 1980



The Evolution of Culture in Animals

John Tyler Bonner

This provocative, fascinating, and delightfully illustrated book traces the origins of culture as we know it back to the early biological evolution of animals.

"... Both lucid and charming.... John Tyler Bonner is a biologist who not only knows a great deal about plants and animals but has thought long and carefully about the problems of evolution.... The pleasure of the book is in the wealth of examples of communication and teaching, many effectively illustrated with drawings or photographs." —*J. Z. Young, London Review of Books.*

52 illus. 9¼ x 6⅛". $14.50

Princeton University Press
Princeton, New Jersey 08540

and entertains. This, I think, is enough.

Smith is visited in August by a Forest Service administrator well versed in land-use planning—a man who is familiar with the uses and abuses of national forests and who values the social, as well as the material, resources of the forests.

"Social resources," he tells Smith, "are resources found in the mind of man." A generation ago, the economic zoning of our national forests was arranged mainly for the benefit of lumbermen, livestock permitees, and mine owners. Today, however, administrators must accommodate users who are interested in recreation, in opportunities for the study of human history and prehistory, in opportunities for natural history research, and in the enjoyment of pure "wilderness" (a word that, in this context, seems to be synonymous with existence value or intrinsic worth).

Smith believes "we are fortunate to have groups such as the Sierra Club, Wilderness Society, and Rocky Mountain Center on Environment that are fighting to preserve wild areas." Strangely, though, he does not belong to either the Sierra Club or Friends of the Earth. The scientists who supply information to these groups are not, he feels, objective. "It has always seemed obvious to me that there is no such thing as a truly unbiased scientist, any more than any other kind of human—and membership in a strong 'advocate' group indicates a strong possibility of bias to me!"

I can't agree. In the real world a person is unlikely to find *any* activist group or political party or religious sect the credo and methods of which he or she can accept unreservedly. Better it is, I think, to join the group—then try gently to bring about the changes within and outside the group one feels are necessary.

Above Timberline can be read as refreshment by anyone. It can be read as education by those who are involved in conserving the green forests and rangelands of the American West. And it can be read as political history by those who study the human exploitation of the natural Earth that allows us life.

Since his retirement from the Fish and Wildlife Service, biologist Victor B. Scheffer has written six books dealing with wild animals. In 1970, The Year of the Whale *was awarded the John Burroughs Medal.*

Sponsor a Child for Only $10 a Month.

At last! Here is a $10 sponsorship program for Americans who are unable to send $15, $16, or $19 a month to help a needy child.

And yet, this is a full sponsorship program because for $10 a month you will receive:

...a photograph of the child you are helping.

...a special sponsorship folder with the case history of the child.

...a description of the country where your child lives.

...a quarterly progress report about your child's community from the field worker.

And you will receive at least two personal letters a year from your child.

All this for only $10 a month?

Yes—because the Holy Land Christian Mission International believes that many Americans would like to help a needy child. And so we searched for ways to reduce the cost—without reducing the help that goes to the child you sponsor.

For example, unlike some of the other organizations, your child does not write each month, but two letters a year from your child keeps you in contact and, of course, you can write to the child just as often as you wish.

Also, to keep down administrative costs, we do not offer the so-called "trial child" that the other organizations mail to prospective sponsors before the sponsors send any money.

We do not feel that it is fair to the child for a sponsor to decide whether or not to help a child based on a child's photograph or the case history.

Every child who comes to Mission International for help is equally needy!

And to minimize overseas costs, our field workers are citizens of the countries where they serve. Many volunteer their time, working directly with families, orphanages, and schools.

You can make a difference!

$10 a month may not seem like much help to many Americans, but to a poor family living on an income of $1.50 or $2.00 a day, your sponsorship can help make all the difference in the world.

Will you sponsor a child? Your $10 a month will help provide so much:

...emergency food, clothing and medical care.

...a chance to attend school.

...help for the child's family and community, with counseling on housing, agriculture, nutrition, and other vital areas to help them become self-sufficient.

A child needs your love!

Here is how you can sponsor a child for only $10 a month immediately:

1. Fill out the coupon and tell us if you want to sponsor a boy or a girl, and check the country of your choice.
2. Or mark the "emergency list" box and we will assign a child to you that most urgently needs to have a sponsor.
3. Send your $10 in right now and this will eliminate the cost of a "trial child."

Then, in just a few days you will receive your child's name, photograph, and case history.

May we hear from you? We believe that our sponsorship program protects the dignity of the child and the family and at the same time provides Americans with a positive and beautiful way to help a needy youngster.



Little Sabina lives with her four brothers and sisters in a little hut on the side of a hill. Her father is dead and her mother tries to make ends meet by selling "tortillas" which she makes by hand each night.

KCG

Holy Land Christian **Mission International**
Attn: Joseph Gripkey, President
2000 East Red Bridge Road
Box 55, Kansas City, Missouri 64141

☐ Yes. I wish to sponsor a child. Enclosed is my first payment of $10. Please assign me a ☐ Boy ☐ Girl

Country preference:
☐ Colombia ☐ Guatemala ☐ India ☐ Chile
☐ The Holy Land ☐ Thailand ☐ Dominican Republic

☐ **OR, choose a child that needs my help from your EMERGENCY LIST.**

☐ Please send me more information about sponsoring a child.

☐ I can't sponsor a child now, but wish to make a contribution of _____.

NAME_____

ADDRESS_____

CITY_____

STATE_____ ZIP_____

The Holy Land Christian Mission International is a member of the Advisory Committee on Voluntary Foreign Aid, and a charter member of the Evangelical Council for Financial Accountability. Our annual financial report is readily available upon request. Please make your check payable to Mission International. Your sponsorship gifts are tax deductible.

Holy Land Christian
Mission International

The Edge of Sight

Human beings, always looking for ways to push back the limits of their senses, have long been dissatisfied with the resolving power of the human eye. The Romans used water droplets and glass to magnify things, but it wasn't until the fifteenth century that the eye's limitations were overcome.

Historians believe that the first microscope, a simple glass magnifier, was invented sometime about 1450 by an unknown entomologist as an aid in drawing insects. As Anton van Leeuwenhoek, Hans Jansen, and others built better microscopes, a strange new world populated by bizarre one-celled animals and tiny plants gradually unfolded. Much later, scientists began to explore the structures inside the cells—mitochondria, Golgi bodies, and the endoplasmic reticulum.

The limitations of light itself, not the human mind, ultimately halted the steady improvement of the light microscope: the wavelength of visible light is simply too long to pick up small details, no matter how powerful the lens. In 1924 a physicist suggested that electrons bounced off a specimen would magnify better than light since the wavelength of electrons is thousands of times shorter. Shortly afterward, a microscope that used electrons was built, and the limits of resolution were again pushed back.

The American Museum of Natural History bought its first electron microscope, a Cambridge S4-10, in 1972 for $90,000. At the time it was one of the best microscopes in the world. But such is the progress of technology that today the S4-10 is considered obsolete, bulky, and inefficient.

This month, technicians in the Museum's Interdepartmental Laboratory will unplug and unscrew the S4-10 and trade it in—plus $120,000—for a brand-new microscope: a Cambridge Stereoscan 250. Most of the funds were provided by a grant from the National Science Foundation obtained by curators Roger Batten and Bruce Haugh, with the help of Robert Koestler, who manages the laboratory. The new scope, of which only ten have been built so far, is one of the finest of its kind. "It's a second-generation instrument," says Koestler. "Everything has been done over."

Like the old scope, the 250 is a scanning electron microscope, or SEM, which produces a three-dimensional picture by bombarding a specimen with a shower of electrons. The electrons are shot down in an evacuated column toward the specimen. Magnetic fields along the column, acting as lenses, focus the electrons into a narrow beam. The beam scans rapidly across the specimen line after line, much like reading a book, and a black-and-white image of the surface of the specimen appears on a television screen. Because electrons, unlike light, have no color, SEM pictures are always black and white.

Electron microscopes in general are much more powerful than light microscopes. The most powerful light microscope can magnify 2,000 times, while the new SEM can magnify up to 570,000 times. To give an example, under a light microscope, the point of a pin looks surprisingly blunt. Under the SEM, however, a pinpoint becomes an entire landscape.

The Museum's new SEM provides an array of fancy electronics that the old one lacked. The banks of vacuum tubes have been replaced by solid-state electronics, a minicomputer automatically adjusts the electron beam for greatest depth of field, and a new 4- by 2-inch specimen chamber will allow Museum scientists to look at specimens that were too large to fit into the old ½-inch chamber. The 250 has twice the resolving power of the old S4-10, eight times the depth of field, and three times the magnification. Even more important for the Museum's research, it can also achieve very low magnifications—about the same as a pair of thick eyeglasses—to look at large specimens. In addition, the Stereoscan 250 offers such options as an "energy dispersive system," "solid-state backscattering analysis," "cathodoluminescence," and "X-ray nucleonics."

The new machine will be used to analyze everything from diamonds and fossilized sea urchins to spider genitals. Koestler estimates that one hundred curators and research associates will use the SEM for their research projects. David Hurst Thomas, chairman of the Department of Anthropology, is studying tool assemblages from an archeological site in Nevada. His results will appear in a 2,000-page Museum monograph on the archeology of the entire Great Basin area. Thomas used the old machine to look at the microscopic wear pat-

The Hopi

A new exhibition at the Museum, *Hopi Kachina: Spirit of Life*, will open February 9 in Gallery 3. The exhibition focuses on the annual kachina ceremonies of the Hopi, one of North America's oldest continuous cultures. Models of Hopi villages, scenes of the cult ceremonies, kachinas, and other Hopi artifacts will be on display. *Hopi Kachina* was organized by the California Academy of Sciences.

Black History

The Museum's African-American Program will observe *Black History Month* with a number of events celebrating the cultural richness and diversity of African and African-American peoples. The programs will be presented in the People Center on four weekends, beginning Sunday, February 1; among them are *Music and Folk Traditions of East Africa, African Toys and Games*, and *African-American Cooking*. Films on related subjects will also be shown during the weekends. All programs are free and will take place throughout the afternoon from 1:00 to 4:30. Other programs commemorating Black History Month—including a multimedia tribute to singer/actor/activist Paul Robeson on Sunday, February 21, at



terns on ancient tools to find out how they were used. But the specimen chamber on the old machine was too small to accommodate most tools, and thus the SEM was only used as a supplement to the light microscope. The larger specimen chamber of the new scope will allow Thomas to do broader, more thorough research.

George Harlow, a curator in the Department of Mineral Sciences, will use the Stereoscan 250 to investigate the structure of asbestos fiber, which is too fine to be seen with the light microscope. Among Harlow's concerns are those properties of asbestos that might induce biological activity. He says, "The more we understand the structure of asbestos and other powdered minerals, the more we will know why such minerals can cause various diseases, including cancer."

Roger Batten, who was the prime mover in getting the old scope, will use the new one for his research on fossil bivalve mollusks. His research is adding to our knowledge of earth history and evolution and, incidentally, providing valuable information for oil exploration. Bruce Haugh is also working on a complex evolutionary problem involving the fossilized microanatomy of echinoderms (sea urchins, starfish). His findings are challenging traditional views of echinoderm evolution.

Other Museum projects that will benefit from the 250 range from a study of feathers to aid in the classification of birds to documentation of mineral localities in New Jersey.

During its lifetime, the S4-10 served the Museum well. It provided thousands of photographs for more than eighty scientific publications and extended the systematic research of the Museum into new areas. As an even more powerful extension of our ability to see, the Stereoscan 250 will add to our understanding of nature.

Douglas J. Preston

2:30 P.M.—will be held in the Education Hall and the Auditorium.

Evening Courses

February marks the beginning of the Education Department's Spring Evening Lecture Series. Over the years, these popular lectures have brought the world of natural history, anthropology, and geology to thousands of interested people.

Studying Birds is a four-evening series that will cover High Andean Birds, Endangered Cranes, Birds of the Amazon and Meadowlarks. Various authorities on birds, including Thomas Lovejoy of the World Wildlife Fund and François Vuilleumier of the Museum's Ornithology Department, will present each lecture. Tuition is $20.

Symbol and Shadow will explore the world of Asian puppetry, using the Museum's extensive puppet collection. Included in this series of five lecture-performances will be Cambodian puppetry and music, the development of shadow theater in China, and a performance of Bali puppets collected by the late Margaret Mead. Tuition is $30.

The Hopi, a six-lecture series, complements the special Museum exhibition Hopi Kachina: Spirit of Life. The illustrated lectures will cover, among other topics, the 1,000-year prehistory of the Hopi, the kachina cult, the Snake Dances, and the fifteenth-century Awatovi murals. Tuition is $30.

Other lecture series are *Anthropology Through Films*, *The World of Islam*, *Mammals of North America*, *Plant Life at the Edge of the Sea*, *Foraging for Dinner*, *Animal Drawing*, *Insects*, and *Explore Weaving*. Write to the Education Department for a brochure and preregistration form.

Junior Natural History

The Education Department is offering four *Workshops for Young People* beginning in February: Exploring with the Microscope, Photographing People, The Arts of Asia, and Games People Play. The workshops add a special dimension to the Museum learning experience for children in grades 4 to 7. Each workshop lasts six weeks, and tuition is $20. Write to the Education Department for details.

Inner Landscape

On Wednesday, February 11, at 7:00 P.M. in the Auditorium, the Education Department and the Society for the Study of Myth and Tradition are presenting *Sacred Geography: An Inner Vision of Ecology*. Free illustrated lectures will explore Native American views of the universe as expressed through myths, stories, afterworld beliefs, and ceremonies.

Films for the Family

On Washington's Birthday (Monday, February 16) a Family Film Festival will be shown in the Auditorium at 1:00 and 3:00 P.M. The free films are especially presented for families visiting the Museum on the holiday.

Cosmic Visions

The February membership program will be *Visions at T Minus Zero*, presented by John Teton. *Visions* incorporates film shorts, including excerpts from science fiction thrillers, cartoons, and NASA clips, into a program about astronomy, cosmology, and the universe. Astronomer Robert Chambers says about *Visions*: "The impact of *Visions* on its audience is tremendous. . . . Teton built a mechanism that got through to people as few things have." The program is free for members, $3.50 for nonmembers, and will be shown on Wednesday, February 25, at 7:30 P.M. in the Auditorium. *Visions* will be repeated on Sunday, March 1, at 2:00 P.M. in the Auditorium.

Additional Reading

Hutterites (p. 34)

According to the *New York Times Book Review,* J. A. Hostetler's *Hutterite Society* (Baltimore: The Johns Hopkins University Press, 1976) is "the definitive history and ethnography of the Hutterites." *All Things Common*, by V. Peters (Minneapolis: University of Minnesota Press, 1965), is a well-written, general study of the Hutterites. J.W. Bennett's *Northern Plainsmen* (Chicago: Aldine Atherton, 1969) is an economic, anthropological study of the different agrarian and adaptive strategies used by Hutterites, Indians, and farmers in the Jasper, Canada, region, while his *Hutterian Brethren* (Stanford: Stanford University Press, 1967) offers insights into the agricultural economy and social organization of the Hutterites of southwestern Saskatchewan. *The Hutterites in North America*, by J.A. Hostetler and G.E. Huntington (New York: Holt, Rinehart and Winston, 1967), is a detailed description of Hutterite daily life. For an insider's perspective, see *The Hutterite Way*, a work written by a Hutterite, P.S. Gross (Saskatoon: Freeman Publishing Co., 1965), which covers the life, customs, traditions, and religion of the Hutterites. The classic history of the Hutterites is J. Horsch's *The Hutterite Brethren 1528–1931* (Goshen: Mennonite Historical Society, 1931). D. Flint's *The Hutterites* (Toronto: Oxford University Press, 1975) examines Hutterite daily life and beliefs, particularly as demonstrated in a Pincher Creek, Alberta, colony. J.A. Hostetler gives the most detailed account of Hutterite child-rearing practices in "Communal Socialization Patterns in Hutterite Society (*Ethnology*, October 1968, pp. 331–55). "The Christian Communists of Canada" (*GEO Magazine*, November 1979, pp. 126–54), which features many color photographs, is M. Holzach's recounting of his experiences living in a Hutterite colony in Canada. An anthropological case study of a related Anabaptist sect, J.A. Hostetler and G.E. Huntington's *Children in Amish Society* (New York: Holt, Rinehart and Winston, 1971) discusses Amish child training and schooling. "The Anabaptist Explosion," by W.F. Pratt (*Natural History*, February 1969, pp. 8–23) explores the traditionally high levels of fertility among the Hutterites and Amish.

Walrus (p. 48)

A systematic account of the pinnipeds, V.B. Scheffer's *Seals, Sea Lions, and Walruses* (Stanford: Stanford University Press, 1958) examines the distribution and variation patterns of these animals. *Diving Companions*, by J.Y. Cousteau and P. Diolé, translated from the French by J.F. Bernard (New York: Doubleday and Co., 1974), recounts the experiences of the *Calypso* crew while witnessing the springtime migration of the walrus in the Arctic. R. Perry's portrait of walrus life and society, *The World of the Walrus* (New York: Taplinger Publishing Co., 1967), discusses human exploitation of the walrus. For detailed descriptions of all seal species, consult G. Maxwell's *Seals of the World* (Boston: Houghton Mifflin, 1967). A popular work treating the yearly rhythms of arctic animals, *The Arctic Year*, by P. Freuchen and F. Salomonsen (New York: G.P. Putnam Sons, 1958), gives extensive coverage to the walrus. The May/June 1980 issue of *Oceans* features a photo essay, "The Pinniped Papers" (pp. 11–17) and two articles by D. Haley: "Tooth-Walking Sea Horse" (pp. 38–44), which provides general information on the walrus, and "Future of the Walrus: Rise Before the Fall?" (pp. 62–63), which explores how discovery of oil and minerals in the Bering and Chukchi seas may affect the area's walrus population. B. Keating's *Alaska* (Washington, D.C.: National Geographic Society, 1971) offers a section on the Diomede Islands. Two recent *Natural History* articles dealing with the walrus, with text and photographs by F. Bruemmer, are "The Gregarious but Contentious Walrus" (November 1977, pp. 52–61) and "Life on a Cold Rock" (March 1977, pp. 54–65).

Acid Rain (p. 58)

The first article in a two-part series on acid rain by S. West in *Science News*, "Acid from Heaven" (February 2, 1980, pp. 76–78), deals with the sources of acid rain; the second, "Acid Solutions," (February 16, 1980, pp. 106–108) looks at the scientific and political problems involved in controlling it. *Environment* published a series of articles investigating acid precipitation: "Acid Precipitation: 1. Causes and Consequences," by H. Babich, D.L. Davis, and G. Stotzky, appeared in the May 1980 issue (pp. 6–13); the June 1980 issue featured G.S. Wetstone's "The Need for a Regulatory Approach" (p. 9), A. Rosencranz's "The Problem of Transboundary Pollution" (p. 15), and Wetstone and Rosencranz on "National and International Responses" (pp. 6–7). "Acid Rain," by G.E. Likens et al. (*Scientific American*, October 1979, pp. 42–51), includes many maps and diagrams charting the rise in acid rain from the mid-1950s to the mid-1970s. In "Acid Precipitation in the Western United States" (*Science*, January 11, 1980, pp. 176–77), W.M. Lewis and M.C. Grant associate the downward trend in pH levels of the last three years with the increase of nitric acid in precipitation. *Acid Rain* (Washington, D.C.: EPA Office of Research and Development, July 1980), a 36-page exploration of acid rain, covers the laws that govern the emissions resulting in acid rain and the research now under way to understand its implications and effects. This publication costs $3.25 and can be ordered by writing to Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 and requesting GPO-055-00-00198-7. *Sulfur in the Environment*, edited by J.O. Nriagu (New York: John Wiley and Sons, 1978), is a two-volume compendium of articles focusing on the behavior and effects of sulfur and the ecological stress created by this pollutant. Other books containing technical material on acid rain are: *Effects of Acid Precipitation on Terrestrial Ecosystems*, edited by T.C. Hutchinson and M. Havas (New York: Planum Press, 1978); *Atmospheric Sulfur Deposition*, edited by D.S. Schreiner, C.R. Richmond, and S.E. Lindberg (Ann Arbor: Ann Arbor Science, 1980); and *Polluted Rain*, edited by T.Y. Toribara, M.W. Miller, and P.E. Moro (New York: Planum Press, 1980). A number of articles by G. Hendrey, on the effects of acid rain

on the aquatic environment, are available from him at Brookhaven National Laboratory, Upton, New York 11973. Papers from the Norwegian project on "Effects of Acid Precipitation on Forest and Fish" can now be obtained by writing to SNSF, 1432 Aas-NHL, Norway. The 315-page *Proceedings of the Action Seminar on Acid Precipitation November 1–3, 1979* (Toronto: ASAP Coordinating Committee, 1980), a less-technical compendium of the papers given at this symposium, is available for $6.50 (Canadian) from the Federation of Ontario Naturalists, 355 Lesmill Road, Don Mills, Ontario, M3B 2W8, Canada.

Wolves (p. 66)

E. Zimen's *The Wolf*, translated by E. Mosbacher (New York: Delacorte Press, 1980), from which the article in this issue is adapted, focuses on wolf ecology and behavior and provides the most thorough coverage of Abruzzi wolves. *The Behavior and Ecology of Wolves*, edited by E. Klinghammer (New York: Garland Publishing, Inc., 1979), is a series of articles exploring the reintroduction of the wolf into the wilds. Organized into five sections—wolves in the wild, analysis of behavior, translocation and reintroduction, wolves in captivity, and the red wolf—this work includes data on Abruzzi wolves. L. D. Mech's *The Wolf* (Garden City: Natural History Press, 1970) is a readable, well-documented, standard text on wolves. M.W. Fox's *Behaviour of Wolves, Dogs, and Related Canids* (New York: Harper and Row, 1971) is an account of the social organization and behavior of some canids and includes a large, illustrated section on the wolf. B.H. Lopez's *Of Wolves and Men* (New York: Charles Scribner's Sons, 1978), a folkloric essay on the wolf, is enriched by a descriptive bibliography.

Rita Campon

Errata: In our December issue the photograph of goldenrod on page 42 was incorrectly identified as ragweed. On page 44, the text should read "destroyed millions of square acres," not "square miles." And on page 58, "one century later," should read "one millennium later."

This course (*specifically designed by the U.S. Department of State for Diplomats with little or absolutely no knowledge of the language to be studied*) is **complete**, **unedited** and includes the official Foreign Service Institute book with text for basic and advanced instruction. It begins in English and will gradually build your skills until you can comfortably handle the entire lesson in your new language. In a matter of weeks, you could be speaking your new language like a member of the U.S. Foreign Service Corps.

ONE LOW PRICE FOR YOU...ALL OTHERS LEARN FREE!

What an incredible value! For the single purchase price of one course your whole family can learn a new language and keep the course for years of fun and future reference.

The *complete* full length Foreign Service Language Course is now being offered in two volumes:

VOL. 1, BASIC SPANISH 15 cassettes (19 hours) and 464 pg. Foreign Service Institute text **$99.95**

VOL. 2, ADVANCED SPANISH 21 cassettes (27 hours) and 464 pg. Foreign Service Institute text **$89.95** (The number of cassettes in FRENCH, GERMAN and ITALIAN Courses vary slightly from the SPANISH Course.)

FREE TRIAL OFFER. Try this course for three weeks. If you aren't convinced it's the fastest, easiest, most economical way to learn a new language, return the course for a full refund with no questions asked. Order yours right now!

For immediate delivery, fill in the information on the bottom of this ad and mail it with your check, Money Order or charge to your AmEx, Visa or Master Card by enclosing card number, expiration date and signature.



LEARN SPANISH, FRENCH, ITALIAN OR GERMAN LIKE A MEMBER OF THE U.S. FOREIGN SERVICE CORPS.

(each course is less than $100!)

Satisfaction guaranteed or your money back. AN IDEAL GIFT!

SPECIAL INTRODUCTORY OFFER!

Order both BASIC and ADVANCED Course in any language and take advantage of a full 10% discount! **Mail to: AMPRO PRODUCTIONS** 150 Fifth Avenue, New York, NY 10011.

NOW you can order by phone 24 hours a day! Call collect (9AM - 6PM EST) **(212) 243-7726**

N.J., N.Y., CT., residents can also buy direct at our Fifth Avenue office (at 20th Street)

Fill in the line below with the language you wish to learn...then check basic, advanced or both.

(Language)

☐ Basic $99.95 ☐ Advanced $89.95 ☐ Both 10% OFF TOTAL NH2

University of California, Berkeley

RESEARCH EXPEDITIONS PROGRAM



1980-81

- Explore marine environments in the South Pacific
- Study bird behavior off the California coast
- Excavate an 18th C. plantation site in Virginia
- Record Ancient Rock Art on Easter Island
- Study butterfly ecology in Australia
- Observe whale behavior in Baja

Be an active member of a small field research team. Your participation and tax deductible contribution make it possible.

NO PREVIOUS EXPERIENCE NECESSARY

For more information on these and other expeditions, contact:

University Research Expeditions Program (UREP), Desk N H
University of California
Berkeley CA 94720 or Phone (415) 642-6586

LYNCHBURG HARDWARE & GENERAL STORE

65 Main St., Lynchurg, TN 37352



Jack Daniel Square Coaster Set

Every once in a while, something comes along which is so simple and direct that I wonder why I didn't think of it myself. Well, even though I didn't think of these, someone at the distillery decided to have a square drink coaster to match the square glass. Pretty clever, huh?

Anyway these six coasters are redesigns of old Jack Daniel advertising art and are full color. Each is different and measures 4⅛" square. They are cork backed and impervious to alcoholic beverages. My **$10.00** price includes postage.

P.S. But I wonder, if they're so smart, why did they make six coasters for only 4 glasses?

Send check, money order or use American Express, Visa or Master Charge, including all numbers and signature. (Tennessee residents add 6% sales tax.)

For a catalog full of old Tennessee items and Jack Daniel's memorabilia, send $1.00 to the above address. Telephone: 615-759-7184



Plate by Mark Catesby From
Vol. II The Natural History of
Carolina, Florida and the Bahamas, 1771

Forbidding Fruit

If eaten before perfectly ripe, the persimmon can be a mouth-puckering experience

by Raymond Sokolov

The only reason anyone without a flat tire stops in Gnaw Bone, Indiana, is to visit the Brown County Sorghum Mill. It isn't really a mill, just a big farm stand on a highway in southern Indiana. It opens for business only during the fall harvest season and sells the typical crops of Brown County's rolling, picturesque farm country: pumpkins, apples, twists of bittersweet, sorghum molasses, apple butter. The mill did not have any of the big goose-necked gourds or the strawberry popcorn, grown on tiny dark red ears, that I had bought at another stand just north of Nashville, a tourist center and artist's colony that makes a big business out of Indiana's log cabin era, with one hokey olde-time shoppe after another flogging folksy crafts and souvenirs. Gnaw Bone has its own specialties.

At the Brown County Sorghum Mill, only three miles or so from Nashville, Nancy Roberts preserves Midwestern homestead tradition without cuteness or hoopla. She makes fudge and candy and a cakelike "pudding" from the fruit of the native persimmon tree. Well, some days she does. But Mrs. Roberts also drives the Gnaw Bone school bus, and she has trouble getting persimmons, which are a tiny and tastier cousin of the Asian variety sold in supermarkets. Her usual supplier, busy with a new job in Indianapolis, hadn't delivered any pulp last fall when I happened by.

"Pulp?" I asked, inwardly cursing Jane and Michael Stern, whose excellent guide to American highway restaurants, *Roadfood*, had led me to this remote hamlet with visions of native persimmons dancing in my head. Instead, there was nary a piece of fudge, just talk of a pulp scarcity.

"She used to process the fruit from her orchard, get rid of the skins and seeds, and sell me the pulp," Mrs. Roberts said. But the supplier wasn't home. Mrs. Roberts didn't know where or on which back road she lived. At any rate, if I came back the next day, Mrs. Roberts would have a batch of persimmon fudge she was going to cook that night from some of last year's pulp still left in her freezer.

I took another tack. I checked the main supermarket in Nashville. No persimmons, at the height of the season. Next, I dropped in at the local office of the U.S. Department of Agriculture's Cooperative Extension Service. The woman behind the counter said there were no proper persimmon orchards in the county. Nobody cultivated persimmons. They just grew wild: in open places, clearings, abandoned fields. You waited until after the first frost and then picked them up off the ground where they fell. Fruit still on the tree was too astringent to eat. The fall had been so mild that the persimmons might not be ready yet. She told me to go look at a tree in her mother-in-law's yard at the edge of town.

An understandably suspicious older woman greeted me and pointed out her tree—slender, fifty feet high, with dark bark deeply divided into squarish sections. Up in the leafless branches I saw tiny orange fruits. The woman's relatives had gathered all the fallen fruit the day before, and the ground under the tree was bare.

At the post office, I got directions to the house of Mrs. Roberts's supplier, the woman with the "orchard." An hour later, after losing my way in a delightful labyrinth of tree-lined lanes, I pulled up to a desolate mobile home set behind a half-built house in the early stages of dilapidation. Stepping out of the car, I was attacked by a small mongrel, a dingy beige bitch who took a bite of my left ankle and would have taken a second helping if another, larger but better-behaved cur had not chased her away. Expecting the report of a shotgun, I waited a minute or two by the car. But no Jukes or Kallikak emerged from the battered trailer, so I limped across the field toward a scraggly stand of trees. A few feet from them, I slipped on what felt like a spot of mud. It was red orange and had three large black seeds. In the branches overhead, hundreds of similar persimmons dangled. And in the brown grass, strewn in every direction, were squishy-squashy ripe persimmons waiting to be saved from their natural predators: squirrels, opossums, skunks, quails, raccoons, and deer.

Having liberated as many fruits as I could gather in my shirt, I retired to the safety of my vehicle. They were definitely the fruit of *Diospyros virginiana*, the American persimmon. Small, about the size of walnuts or cherry tomatoes, they resembled the much larger, heart-shaped oriental persimmon (*Diospyros kaki*) only in color and in the gooey texture of their inner flesh. In flavor, these American persimmons far surpass their imported cousins. They are powerfully fragrant,

Adelaide de Menil



The American persimmon (Diospyros virginiana)

sweet and luscious, and taste like dates. Indeed, one of their vernacular names is date plum. They are wonderful fruits.

Early settlers realized this almost immediately upon their arrival in America. DeSoto wrote the first description of the persimmon in 1539 in Florida. The name itself apparently derives from the Algonquin *putchamin* or *pasiminan*, meaning "dried fruit." Well into the colonial era (and perhaps still) dried persimmons were stored and eaten like figs. Colonists must also have learned from Indians that the little fruit lent itself to baking in breads, cakes, and puddings. And we can be sure the Pilgrims had the good sense to consume persimmons out of hand, knowing from bitter experience that they had to wait for this treat until the natural ripening process had masked the fruit's tannin and made it sweet. As Capt. John Smith put it: "If it not be ripe, it will drawe a man's mouth awrie with much torment; but when it is ripe, it is as delicious as an Apricock."

Easily grown from seed, the persimmon was established in English gardens before 1629 and was introduced into Europe in the early eighteenth century, where it can still be found, but sun-starved American persimmons in the Old World rarely reach a height of more than thirty feet. On native ground, persimmons do much better, normally topping out at something under fifty feet.

D. virginiana is a member of the Ebenaceae family, but unlike almost all the other ebonies, it is not tropical. Its range extends across the United States from Florida and Texas into New England. Particularly valued for its timber, this hardwood has been characteristically employed for shoe lasts, weaver's shuttles, and golf club heads. The dark heartwood takes a century to develop, but then it surpasses in hardness any native wood except ironwood and dogwood.

Small flowers bloom in early June and typically evolve into ripe fruit by October. Contrary to persistent folklore, frost has nothing to do with the ripening process. Indeed, the notion that a hard frost was required before the fruit would lose its tannic, mouth-puckering astringency has probably kept the native persimmon from achieving popularity as a commercial fruit. Everyone I met in Indiana told me that frost was essential, and that I should only attempt to eat fruit that had fallen on the ground. Unimpeachable botanical authority asserts that this is false, that fruit with a good, dark orange color should be picked while still solid (cut rather than pulled from the stem), and that it can be ripened fully, until it is very soft, off the tree. I tested this proposition with several firm fruits, and it is so. Furthermore, ripening can be hastened along by bagging persimmons together with an apple.

In other words, there is no reason to wait until persimmons have fallen to the ground from their own heaviness and gone smash. A commercial grower could easily harvest a crop while it was still firm enough to travel and get it to market in good shape. Off-tree ripening, by the evidence of my own experiment, produces just as flavorful a fruit as the benign neglect preached by tradition.

Other factors besides the frost legend have also worked against popular acceptance of the persimmon. The fruit is small. Most varieties have several seeds. Indeed, the seeds are such a prominent feature of the fruit that a woman in Bloomington, Indiana, told me there was a local tradition of using them to divine the severity of the approaching winter.

Seeds, tannin, and frost legend notwithstanding, it has been obvious to everyone who ever tried a ripe persimmon that it was a fruit of enormous appeal and sophistication worth commercial exploitation. At the end of the nineteenth century and the beginning of the twentieth, nurserymen developed various cultivated varieties: some early blooming, one virtually seedless. But a market never materialized. City people didn't want native persimmons. But the cultivars are still available.

Those interested in planting a persimmon tree should write Gerardi Nursery, Route 1, O'Fallon, Illinois 62269 or California Nursery Company, Box 2278, Fremont, California 94336 or Waynesboro Nurseries, Waynesboro, West Virginia 22980. Do not try to transplant a wild tree without professional assistance, as the extremely deep taproot makes this a very dicey project. I met a man in Brown County who had failed on several tries. He at least had several other trees that bore fruit almost at his doorstep. And almost no one was competing with him for their bounty.

Only the initiated seem to bother with wild persimmons, which are either out of reach, overly tannic, or lying squashed or unappealingly flaccid on the ground. I was able to glean another shirtful at the edge of a recreational vehicle parking lot in Brown County State Park. Vacationers sitting on vinyl folding chairs eyed me with disdain as I gathered persimmons from a nearby grassy knoll littered with fruit and the paper debris of human tourism.

Some of those same rusticating urbanites must have driven home and found bigger but not nearly as interesting heart-shaped oriental persim-



The 80 proof drink with a taste you don't have to acquire.

COINTREAU

COINTREAU LIQUEUR, 80 PROOF. RENFIELD IMPORTERS, LTD., NY ©COINTREAU CORP., 1980.

mons in their markets for fifty cents apiece. In recent years, *Diospyros kaki* has established a foothold in U.S. groceries as a specialty fruit. With a long history as a cultivated plant in Asia (especially in Japan, where it is more popular than all other fruits except citrus and amounts to the national fruit), the *kaki* persimmon has been astutely marketed.

Meanwhile, the native fruit, clearly superior, remains misunderstood and neglected. Country people who value it gather it in the same spirit of woodland foraging that they approach wild mushrooms. And they have preserved the dozens of recipes developed for *D. virginiana* in earlier times. Bear Wallow Books (P.O. Box 579, Nashville, Indiana 47448) publishes a cookbook completely devoted to the various persimmon cakes, puddings, breads, cookies, pies, salads, ice creams, and candies that Hoosiers have traditionally prepared.

Early settlers in Pennsylvania made persimmon wine. In Virginia and Maryland, they distilled persimmon brandy. As a girl in Freetown, Virginia, Edna Lewis helped to make persimmon beer. In *The Taste of Country Cooking*, she recalls:

> We would pick over all that we had gathered and then stir them into a medium-soft batter made from the bran of white cornmeal mixed with spring water. After it was all well mixed, we would spoon the batter into a large bread pan and bake it in the oven. After it had baked and cooled, the cake was placed in a stone crock or a wooden keg with twice as much spring water, then covered and left to ferment until Grandfather decided it was ready for drinking—usually in late winter.

"Simmon" beer will never replace Schlitz. And the American persimmon will probably never supplant the oriental persimmon in American markets. *D. kaki* has an even bigger head start over its native rival than Honda has over Chrysler's K cars. But even Hirohito would probably agree that our persimmon is better than his. This isn't chauvinism, but fact. Anyone who needs further convincing can just head for Gnaw Bone in the fall. If Mrs. Roberts doesn't have any fudge (which is delicious and worth waiting a day for), just find a tree and start eating.

Raymond Sokolov is a free-lance writer whose special interest is the history and preparation of food.

Adelaide de Menil



Bear Wallow Persimmon Pudding

1 egg, lightly beaten
2 cups persimmon pulp (made by pushing ripe fruit through a colander)
3/4 cup sugar
3 cups milk
2 cups sifted flour
1/2 teaspoon baking soda
1 tablespoon butter, cut in small slivers
1/4 teaspoon salt
1/2 teaspoon vanilla

1. Preheat the oven to 350 degrees.
2. Stir the egg into the pulp. Then stir in the sugar.
3. Next, stir in the milk and flour, alternating between the two, adding a half cup or so at a time. Beat well.
4. Dissolve the baking soda in a teaspoon of hot water and beat it into the persimmon mixture. Then beat in butter.
5. Pour into a greased 9 by 13 baking pan. Bake for 1 to 1½ hours, or until dark in color. Four or five times during baking, stir mixture so that it will not harden at edges of pan. (Remove pudding from oven each time so as not to lose oven heat during stirring.)

Yield: 8 to 10 servings

Jeffrey Steingarten's Persimmon Ice Cream

1 cup milk
3/4 cup sugar
Juice of 1 large lemon
1¼–1½ cups persimmon pulp
2 cups heavy cream (avoid ultra pasteurized cream if at all possible)

1. Scald milk. Stir in sugar until dissolved. Cool to room temperature.
2. Stir lemon juice and pulp into milk mixture. Then stir in cream. Correct taste if necessary by adding more lemon juice.
3. Chill 8 to 10 hours or overnight, if possible.
4. Freeze in an ice cream freezer.

Yield: 5 to 6 cups

World praise for the new World Car

"...almost a dream car..."
EXPRESSEN, SWEDEN

"...Ford's cam-in-head (engine) can produce both economy and...energy."
CAR & DRIVER, USA

"The most advanced technical characteristics Ford has ever produced."
AUTO SPRINT, ITALY

"This destiny car is marvelous all around..."
BILD ZEITUNG, GERMANY

"Economical, fuel-and-space efficient... entertaining to drive..."
ROAD & TRACK, USA

"Road Test magazine's Car of the Year!"
ROAD TEST, USA

Ford engineers all around the world worked together to build a technologically advanced, economical automobile—Ford Escort, the new World Car.

44 EST HWY* (30) EPA EST MPG*

*Applies only to sedans without power steering or A/C. For comparisan. Your mileage may differ depending on speed, distance, weather. Actuol hwy mileage ond Colif. rotings lower. Excludes diesels.

Now, both the American and the overseas versions are winning accolades from automotive experts in their countries.

And no wonder. The compact Escort has front-wheel drive, a new-design hemispherical head engine, 4-wheel independent suspension, and better gas mileage ratings than subcompacts like VW Rabbit, Honda Accord, Toyota Corolla Hatchback.

See it at your Ford dealers.

Built to take on the world... and doing it!



hexa·photo·cybernetic
The Possibilities are Endless.



Stopped-Down:

Six-mode exposure control. System versatility. Newer electronics for wider applications.



The Canon A-1 is one of the world's most advanced automatic SLR cameras. Combining the finest in optical and mechanical engineering with the most sophisticated electronics, it's technology applied to give you the ultimate in creative control. At the touch of a button.

Depending on your subject, you can choose from six independent exposure modes to achieve the results you want:

1 Shutter-Priority: You select the shutter speed, to freeze the action and prevent camera shake or create an intentional blur. The A-1 automatically selects the appropriate lens opening.

2 Aperture-Priority: Control the area in focus by selecting the lens opening for the effect you want. The A-1 matches with the right speed.

3 Programmed: When you need to shoot fast, just focus. The A-1 will select *both speed and aperture* for great results.

4 Stopped-Down: For extreme close-up or specialized photography, a bellows, a microscope or almost anything can be attached to the A-1. It's still automatic.

5 Flash: Totally automatic flash photography, of course, with a wide variety of Canon Speedlites to choose from.

6 Manual: Yes. For those times when you absolutely want to do it all yourself. To experiment. To explore the possibilities.





There are over forty fine Canon lenses ranging from Fish Eye to Super Telephoto, plus accessories to meet every need. If you can't photograph your subject with a Canon A-1, it probably can't be photographed.

From the sophistication of its LED viewfinder display, to a ruggedness that allows up to five-frame-per-second motor drive, the Canon A-1 represents an incredible technology. At a price that makes owning one a definite possibility.

Canon® A-1

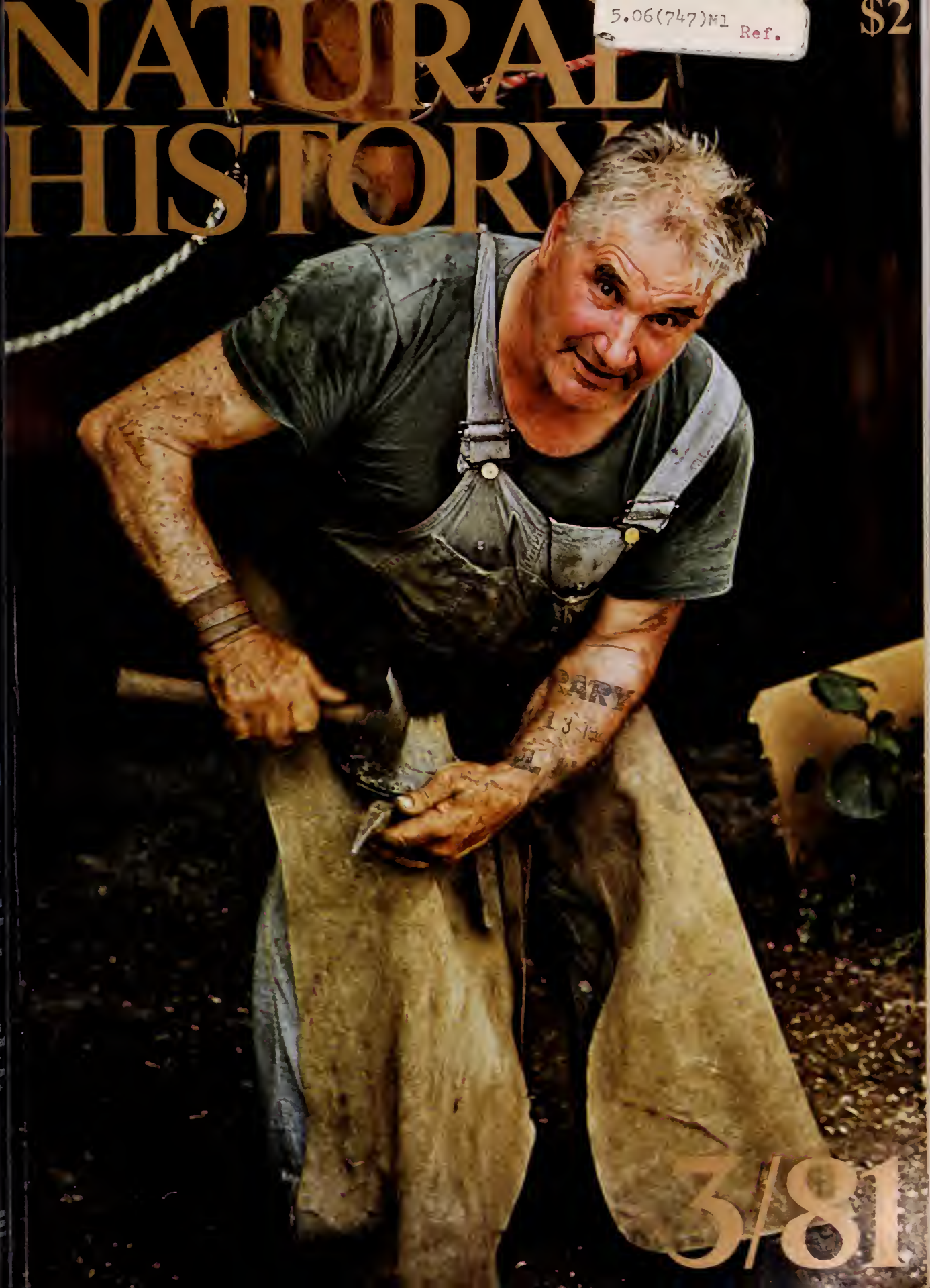
Canon USA, Inc., One Canon Plaza, Lake Success, New York 11042 · 140 Industrial Drive, Elmhurst, Illinois 60126 · 6380 Peachtree Industrial Blvd., Norcross, Georgia 30071 · 123 Paularino Avenue East, Costa Mesa, California 92626 · Bldg. B-2, 1050 Ala Moana Blvd., Honolulu, Hawaii 96814 · Canon Optics & Business Machines Canada, Ltd., Ontario

© 1980 Canon U.S.A., Inc.

5.06(747)M1 Ref.

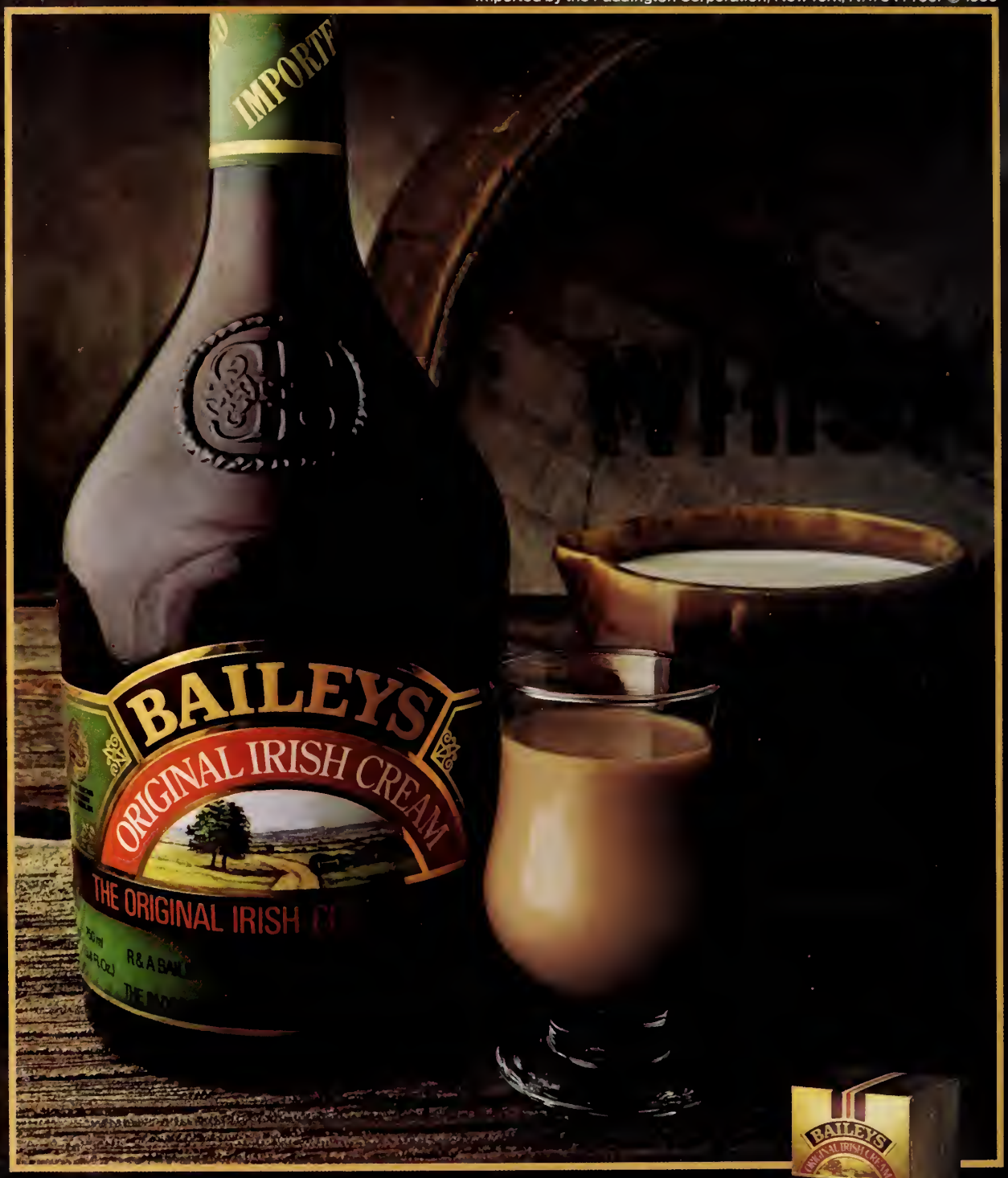
NATURAL HISTORY

$2



3/81

Imported by the Paddington Corporation, New York, N.Y. 34 Proof © 1980





BAILEYS.
THE ORIGINAL IRISH CREAM LIQUEUR.

THE CREAM IS REAL. THE WHISKEY IS REAL.
ONLY THE TASTE IS MAGIC!

The 1981 **Natural History** *Magazine Photographic Competition closes April 1.... See page 106.*

NATURAL HISTORY

Vol. 90, No. 3, March 1981

American Museum of Natural History
Robert G. Goelet, President
Thomas D. Nicholson, Director

6 Authors

12 The Human Strategy *John L. Gwaltney*
Heirs of Disaster

28 Bios *Robert E. Cook*
Toxic Tailings and Tolerant Grass

42 This View of Life *Stephen Jay Gould*
Kingdoms Without Wheels

50 The Seeds of Botany *Thomas A. Christopher*
More than four hundred years ago plant science blossomed in a small Italian city.

58 Last Call for the Siberian Crane *George Archibald*
A great bird, doomed to traverse regions of human warfare and hunger, may soon vanish.

64 Genesis of the *Gossamer Condor* *Morton Grosser*
One of the great feats of human flight was inspired by the study of soaring birds.

72 Vermont Country Calendar *Eleanor A. Ott*
Mud season is about to begin.

84 Deadwood Decomposers *Mark Deyrup*
Single Douglas fir trees become the stage for a myriad of living interactions.

92 Books in Review *Ian Tattersall*
A Sad Reflection of the Outside World

98 Sky Reporter *Stephen P. Maran*
A Near Miss

104 Celestial Events *Thomas D. Nicholson*

108 At the American Museum
Nelson's Glass Eye and Other Tricks of the Trade

114 Additional Reading

116 A Matter of Taste *Raymond Sokolov*
Blueberry Blues

Cover: *Itinerant blacksmith Leo Carrier of Underhill, Vermont, shoes a horse. Photograph by Nathan Benn; Woodfin Camp. Story on page 72.*

Alan Ternes, Editor
Judith Friedman, Managing Editor
Thomas Page, Designer
Board of Editors:
Sally Lindsay, Frederick Hartmann, Vittorio Maestro, Rebecca B. Finnell
Carol Breslin, Book Reviews Editor
Florence G. Edelstein, Copy Chief
Rita Campon, Copy Editor
Angela Soccodato, Art Asst.
Kay Zakariasen, Picture Editor
Douglas J. Preston, Publications Editor
Susan Rosenberg, Editorial Asst.
Lillian Berger
Editorial Advisers:
Malcolm Arth, James W. Atz, Niles Eldredge, Kenneth L. Franklin, E.Craig Morris, Norman Newell, Thomas D. Nicholson, Martin Prinz, Gerard Piel, Nina Root

David D. Ryus, Publisher
Bradford D. Smith, Business Manager
Frederick E. Grossman, Production Mgr.
Ernestine Weindorf, Administrative Asst.
Elaine M. Callender, Advtg. Production Mgr.

Barbara Lynn Gutman, Circulation Mgr.
Daniel J. Dynan, Asst. Circulation Mgr.
Bob Bruno, Fulfillment Mgr.
Ramón E. Alvarez, Circulation Asst.

NATURAL HISTORY *(ISSN 0028-0712), incorporating Nature Magazine, is published monthly by the American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024. Subscriptions: $15.00 a year. In Canada and all other countries: $18.00 a year. Second-class postage paid at New York, N.Y. and at additional offices.*

Copyright © 1981 by American Museum of Natural History. All rights reserved. No part of this periodical may be reproduced without written consent of Natural History. *The opinions expressed by authors do not necessarily reflect the policy of the American Museum.* Natural History *is indexed in* Reader's Guide to Periodical Literature.

Advertising Offices:
Natural History Sales
488 Madison Avenue
New York, N.Y. 10022
President of Sales, Arthur Hill Diedrick
Advertising Manager, Katherine José

Telephone Numbers:
Advertising Sales (212) 826-9467
Museum Information (212) 873-4225
Subscription Orders (800) 526-0331 outside N.J.
(800) 932-0834 in N.J.

Change of address notices, undeliverable copies, orders for subscriptions, and other mail items are to be sent to
Natural History Membership Services
Box 4300
Bergenfield, New Jersey 07621



Last Chance to Buy at These Low Prices

This is the FINAL OFFER at these LOW PRICES. Inflationary pressures require a moderate price increase effective May 31, 1981. However, those who enter a new subscription before that date will be guaranteed price protection at current prices for the first two full years of enrollment. Act immediately to beat the scheduled price increase, and be eligible to continue to buy these luxurious volumes at today's low prices well into 1983.

The Luxury Of Full Leather Bindings

Do not confuse these masterful editions with other volumes which feature partial leather bindings on the spine only.

There is no comparison! Every book in this collection is fully bound in genuine leather. Once you have experienced owning editions of such superlative quality, you will fully appreciate the extraordinary difference.

The 100 Greatest Books Ever Written

The world's greatest works of literature bound in genuine leather and accented with real 22kt gold.

It is not difficult to list the world's greatest books. The titles and authors leap quickly to mind. And for good reason. The books that have been recognized as great, generation after generation, are part of the world we live in. They have shaped our lives, our language, our values, our outlook.

These books include novels like Melville's *Moby Dick,* Dickens' *A Tale of Two Cities,* Hawthorne's *Scarlet Letter,* Bronte's *Wuthering Heights.* They include serious—yet highly readable—works of thought like Plato's *Republic*...heroic epics like Homer's *Iliad*...sharp-witted satire like Swift's *Gulliver's Travels*...brilliant poetry like Whitman's *Leaves of Grass.*

On everyone's list would be the great works of Shakespeare, Chaucer, Dante, Darwin, and Twain. These are books you want on your bookshelf. Books you want your children and their children to read. And now you can have them—the ultimate private library.

The Volumes Themselves are Works of Art

Your pride in this collection will be twofold—arising both from the significance and stature of each literary masterpiece ...and from the sheer beauty of each volume. Every volume in this unique private library will exemplify the ultimate in the art of printing, binding, and illustration.

Genuine Leather Bindings

Today it is rare to find books bound in genuine leather. The cost of such bindings and the time required to create them has made the crafting of such bindings an almost vanishing art. **But each book in this collection will be bound in genuine leather!**

Intricate Cover Designs Accented With Real 22kt Gold

Each luxurious leather binding will be deeply inlaid with real gold on the spine and in perfectly-matched golden designs on the front and back covers. Then, to bring out the full beauty of each cover design, the pages will be gilded along all three sides with a special golden finish.

Elegant Finishing Touches

Each volume will have beautiful endsheets of rich moiré fabric and a matching ribbon page marker. Each volume will be bound with a "hubbed" spine that is characteristic of only the finest books. In every respect, this is to be a collection which rivals anything seen in the great private libraries of days gone by.

Exciting Diversity

The hallmark of a distinctive library is diversity. Therefore, the volumes in the

(continued on next page)



(continued from previous page)

collection will vary in size, in the leathers used, in the distinctive cover designs, and in the illustrations. Yet the collection as a whole will exhibit an unmistakable harmony, because the volumes will be of consistent quality throughout.

Convenient Acquisition Plan

Because of the extreme care and craftsmanship required in printing and binding, the books in the collection will be issued at the rate of one per month. It will give you great pleasure to see your collection becoming more impressive with each passing month.

Comparable books bound in genuine leather command as much as $75 per volume. However, you will be pleased to learn that the volumes in this collection will be priced at only $33.50 each for the first two full years. Future volumes will be similarly priced subject to minor periodic adjustments to reflect varying material costs.

If you desire, you may return any volume within 30 days for a full refund. Moreover, you may cancel your subscription at any time.

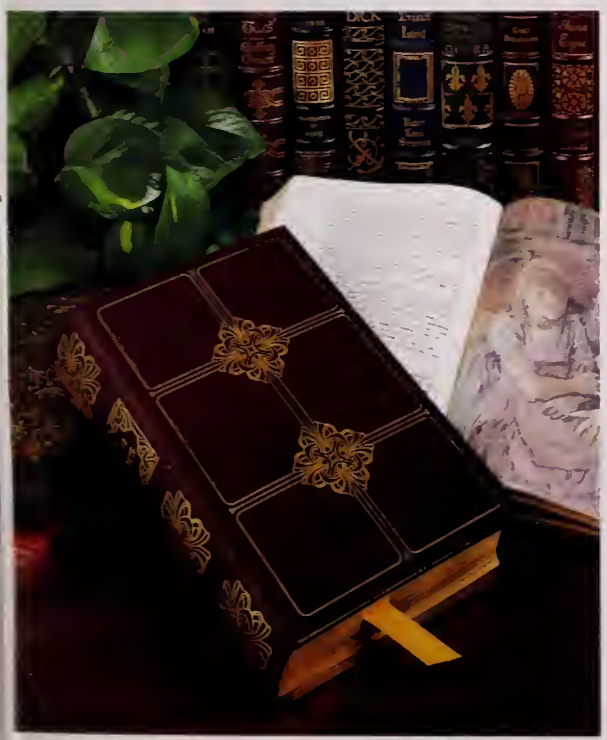
R.S.V.P.

To accept this invitation, you need only complete the Preferred Subscription Reservation and return it to us. This simple step is all that is necessary for you to begin building a private library of your own that is sure to be envied by all who see it.



Last Chance to Buy at These Low Prices

This is the FINAL OFFER at these LOW PRICES. Inflationary pressures require a moderate price increase effective May 31, 1981. However, those who enter a new subscription before that date will be guaranteed price protection at current prices for the first two full years of enrollment. Act immediately to beat the scheduled price increase, and be eligible to continue to buy these luxurious volumes at today's low prices well into 1983.



MUST BE POSTMARKED BY MAY 31, 1981 TO QUALIFY FOR TWO YEAR PRICE PROTECTION AT CURRENT LOW PRICES 468

The 100 Greatest Books Ever Written

The Easton Press
47 Richards Avenue
Norwalk, Conn. 06857

No payment required.
Simply mail this subscription reservation.

Please send me the first volume of **The 100 Greatest Books Ever Written** bound in genuine leather and reserve a subscription in my name. Further volumes will be sent at the rate of one book per month at $33.50* each. This price will be guaranteed for the next two full years.

A list of books scheduled for future monthly shipment will be sent to me. I may indicate which titles on this list, if any, I do not want to receive, thereby insuring that I never receive any books I do not want. I understand that I may return any book within 30 days for refund, and that either party may cancel this subscription agreement at any time.

**Plus $1.75 per book for shipping and handling.*

Payment Options (Check One):

☐ Charge each volume to my: ☐ Master Charge ☐ VISA

Credit Card No. _____ Expiration Date _____

☐ Enclosed is $35.25**(payable to Easton Press) for my first volume.

☐ Bill me $35.25**prior to shipment for my first volume.

Name _____

Address _____

City, State, Zip _____

Signature _____

**Connecticut residents pay $37.90 to include sales tax.

Staff horticulturist at the Lamont-Doherty Geological Observatory of Columbia University, **Thomas A. Christopher** has a certificate in horticulture from the New York Botanical Garden and a degree in classics from Brown University. His article on the botanical garden at Padua grew out of his research on the history of the gardens of Italy, especially those of imperial Rome. Christopher points out that although "classics and horticulture may seem an unlikely combination of interests, the background in classics has provided me with the knowledge of languages and the techniques of research necessary for a study of historic gardens, while garden history has, in turn, provided a fascinating sidelight on the study of ancient and modern civilizations."





After the builders of the *Gossamer Condor* captured the Kremer Prize for human-powered flight in 1977, **Morton Grosser** was invited to join the team for its next project: the design and construction of the *Gossamer Albatross*, the plane that would make the first human-powered flight across the English Channel. Grosser's special responsibility, as an author and engineer, was to chronicle the *Gossamer* ventures in a book, a chapter of which has been adapted in this issue of *Natural History*. With a master's degree in mechanical engineering and a doctorate in the history of science, Grosser has been both a teacher and design engineer. He divides his time between writing and serving as an independent consultant in technology assessment and management.

When she arrived in Vermont in 1969 to teach folklore and folk life at Goddard College, **Eleanor A. Ott** (right) was fortunate enough to meet someone who could instruct her in the traditional ways of local rural life. This was Lucille Cerutti, who has shared with the author her lifelong experience of seasonal activities, from sap gathering and spring planting to deer hunt-





Mark Deyrup claims that he became interested in insects at the age of two, and that he made his first collection at the ripe age of four. An assistant professor of entomology at Purdue University, he is now engaged in investigating the biology of Indiana bark beetles and other insects that inhabit wood. The long-term goal of the project is to obtain information on the structure of insect communities in deadwood, the overlap of communities, and the niche breadth of in-

"I grew up with a great love of birds," writes **George W. Archibald**, "and kept an entire menagerie of ducks and geese at home in Nova Scotia. I remember doing my undergraduate thesis on cranes, being captivated by them, and going on to do graduate work on them." He has been working on the captive propagation of Siberian cranes since 1974, and is also doing research on the breeding ecology of red-crowned cranes and the migration and ecology of Siberian cranes in the USSR and the People's Republic of China, as well as the ethology of hooded cranes. Archibald is cofounder and a member of the board of directors of the International Crane Foundation in Baraboo, Wisconsin.



ing and the celebration of snowy winter holidays. The two have collaborated on making hog's head cheese, red flannel hash, and snapping turtle stew. In addition to Vermont folk life, history, and archeology, Ott's interests include Native American shamanism, stone monuments of prehistoric Britain, and the nesting habits and migration patterns of birds.





dividual organisms. Sequential change in communities and quantitative studies of insect-mediated decomposition rates will also be part of the research. In 1971 Deyrup began working on the Douglas fir beetles, but he soon began looking at the associates of the associated insects and became entangled in the community web. At present he is attempting to come up with a title for himself more euphonious and euphemistic than "deadwood entomologist."

Q. What is the WEBSTER'S NEW UNABRIDGED 20TH CENTURY DICTIONARY about?



A. It's about 2,300 pages and more than 4 inches thick!

For more than 40 years Webster's Unabridged Dictionary has served as an invaluable reference for students, teachers, businessmen, secretaries ... and workers in all trades and professions. The reason is simple. Here is a dictionary that supplies the need for accurate and full definitions, correct spellings and pronunciations, full etymologies, synonyms, as well as other general and specific information

A large staff of lexicographers and linguists has painstakingly edited and updated each definition so that it is clear, accurate, and readily understood in all its senses. Many new entries have been added, including recent additions to the language in the natural and social sciences, the humanities and other specialized branches of human knowledge

un à bridged', *a.* not shortened; complete; specifically, designating a dictionary that has not been abridged from a larger work.
un ac cent'ed, *a.* not accented; specifically, in

The large, clear, legible type shown above (actual size) "makes this unabridged dictionary the most readable one in print."

...now own one of the finest reference books in the world at only ⅓ of its originally published price.

NEW DELUXE COLOR EDITION Includes Thousands of Illustrations Along With 32 Full Color Pages Plus a Full Collection of the Maps of the World

Plus it contains these important supplements!

1. A Dictionary of Biography
2. A Dictionary of Geography
3. A Dictionary of Noted Names in Fiction, Mythology Legend
4. A Dictionary of Foreign Words and Phrases
5. A Dictionary of Scripture Proper Names and Foreign Words
6. Abbreviations Commonly Used in Writing and Printing
7. Practical Business Mathematics
8. Forms of Address
9. Tables of Weights and Measures
10. Special Signs and Symbols
11. Presidents of the United States
12. Vice Presidents and Cabinet Officers of the United States
13. Declaration of Independence
14. Constitution of the United States
15. History of Canada
16. Charter of the United Nations
17. Air Distances between Principal Cities
18. Principal Geographic Features of the World
19. Commercial and Financial Terms

BARNES/SALE & NOBLE/ANNEX

SAVE $40

MAIL ORDER WD429
126 FIFTH AVE., N.Y.C. 10011

PUBLISHED AT $59.95
NOW ONLY $19.95

Please rush me ___ *Webster's New Unabridged Dictionary* at your special sale price of $19.95 (plus $3.00 postage and handling)
N.Y. Residents Add Sales Tax

Mr ☐ Ms ☐
NAME (Please print clearly)
ADDRESS
CITY ZIP

FOR FASTER SERVICE
CREDIT CARD CUSTOMERS CALL TOLL FREE
1-800-228-2051 / EXT. 15
Lines are open 24 HOURS
7 DAYS A WEEK including Sundays
In Nebraska call 402-571-4900

1981 Barnes & Noble Bookstore, Inc.

THE BARNES & NOBLE MAIL ORDER GUARANTEE
Every book you purchase from Barnes & Noble by mail must meet your standards. If not... return it for a full refund within 30 days or credit to your charge account.

In business for 105 years Barnes & Noble has become the world's largest bookstore. (See the current Guinness Book of World Records.) Our goal is to sell the finest books in the world at the lowest possible prices. Ask about us at your local school or public library.

I prefer to charge this purchase: Check One
master charge
4 digits above your name

Account# Exp.
Signature

The Country Music Foundation, Nashville, Tennessee,
is proud to announce its Official Archive Collection

THE GREATEST COUNTRY MUSIC RECORDINGS OF ALL TIME

**Unprecedented and unequaled in our time—
the complete and definitive collection of America's
country and western music.**

- *The best of 75,000 records from the Foundation archives and the vaults of every country music label.*
- *The first collection to include all the great country artists.*
- *Featuring all the great hits, the milestone performances, out-of-issue pressings and unreleased recordings.*

For the first time in history, the greatest recorded performances of country music's greatest artists will be brought together in a single, definitive collection. It will include the most important recordings by the leading country artists of today . . . landmark performances by legendary greats . . . and all the diverse and varied musical styles that have enriched America's country music.

This remarkable collection is the official issue of the Country Music Foundation – home of the Country Music Hall of Fame and Museum, and the world's largest library of recorded country music. And it is the first complete collection that the Foundation has ever issued honoring *The Greatest Country Music Recordings of All Time.*

A unique collection that only the Country Music Foundation could assemble

To assemble this collection, the staff of the Country Music Foundation carefully reviewed the Foundation's own archives of 75,000 records. In addition, they enlisted the support of all the country music record companies – whose vaults hold many of the master recordings selected for this collection. And they were able to obtain rare recordings from private collectors and country music artists themselves.

As a result, the Country Music Foundation Official Archive



"Country is the music of the people. Songs of the soil, forsaken and fulfilled love. Story songs whose music is both contemporary and timeless . . . I love it, and I am proud to be part of the first collection to tell the whole country music story."
—Johnny Cash

© 1981 FMRS



SUBSCRIPTION APPLICATION

The Greatest Country Music Recordings of All Time

Please mail by March 31, 1981.

The Franklin Mint Record Society
Franklin Center, Pennsylvania 19091

Please enter my subscription for *The Greatest Country Music Recordings of All Time*, consisting of 100 proof-quality records in custom-designed hardbound albums. I understand that I may discontinue my subscription at any time upon thirty days' notice.

No payment is required at this time. I will be billed for each record in advance of shipment at $9.75* plus $1.75 for packaging, shipping and handling. My records will be sent to me at the rate of two per month.

☐ Check here to receive the collection on standard Dolby† encoded tape cassettes. Same price as above, shipped two per month.

*Plus my state sales tax

Signature _____
ALL APPLICATIONS ARE SUBJECT TO ACCEPTANCE

Mr.
Mrs.
Ms. _____
PLEASE PRINT CLEARLY

Address _____

City, State, Zip _____

© 1981 FM

† *Trademark of Dolby Laboratories*

A

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

XJ

BUSINESS REPLY MAIL

FIRST CLASS PERMIT NO. 1 FRANKLIN CENTER, PENNSYLVANIA

POSTAGE WILL BE PAID BY ADDRESSEE

THE FRANKLIN MINT RECORD SOCIETY
Franklin Center, Pennsylvania 19063

B

Collection is unique both in scope and importance. A collection that would be difficult – or impossible – for any individual to duplicate.

All the great performers

The collection will feature milestone recordings from the careers of country music's most important artists. Such *great contemporaries* as Loretta Lynn, with 'Blue Kentucky Girl,' 'Coal Miner's Daughter.' Kenny Rogers and The First Edition, with 'Ruby, Don't Take Your Love to Town.' Johnny Cash with 'I Walk The Line' and 'Sunday Morning Coming Down.' Dolly Parton, with 'Coat Of Many Colors' and 'My Tennessee Mountain Home.' The "outlaw" music of Willie Nelson. The Nashville sound of Chet Atkins and Eddy Arnold. Country rock, with The Charlie Daniels Band. And country classics by such other popular music artists as Linda Ronstadt, Glen Campbell and Anne Murray.

Also included will be the unforgettable recordings of such long-time *favorites* as Hank Snow, Ernest Tubb and Merle Travis. The *legendary giants:* Hank Williams, Patsy Cline, Jim Reeves, Flatt and Scruggs, and Jimmie Rodgers. And recordings that reflect regional influences and evolving musical styles – *bluegrass, Cajun, country gospel, western swing, honky tonk* and *rockabilly.*

The collection will include such *rare recordings* as Vernon Dalhart's 1924 recording of 'The Prisoner's Song' – country music's first million selling record, and Loretta Lynn's early classic 'Honky Tonk Girl' – now out of issue. And from the Foundation's archives will come *previously unreleased recordings* – studio "takes" never before made generally available.

Records of superior quality

Every step has been taken to ensure the *technical excellence* of the collection. Thus, all of the *early* recordings will first undergo a painstaking restoration process in the Country Music Foundation's newly opened Audio Restoration Laboratory. Here, recordings of classic performances will be electronically "cleaned" groove-by-groove to eliminate extraneous surface noise and preserve the original sound.

To produce the records, the Foundation has appointed The Franklin Mint Record Society – judged by audio experts to be a leader in producing records of superior quality. The vinyl used will be of a special formula containing its own anti-static element. This material, together with the careful process by which the pressing is made, results in a record that is more rigid, durable and resistant to dust. A true *proof-quality record* – providing exceptional tonal fidelity and clear, clean sound when played through any of today's audio systems.



In the Foundation's audio laboratory, the latest electronic techniques are used to restore the original sound quality of early recordings. Then, the records are pressed in a dust-free "clean room," where strict production standards, and audio and visual inspection, assure high quality.

Fascinating musical "program" in each album

Custom hardbound albums have been designed to house and protect all 100 proof-quality records in this collection.

Each album will contain two long-playing records, presenting a program of artists and recordings carefully selected by the Foundation, and unique to this collection. And each album will be accompanied by specially prepared program notes, illustrated with photographs from the Foundation's permanent collection.

Available by subscription only

If you have a long-standing interest in America's country music . . . or are just discovering its rich and exciting sound . . . this Official Archive Collection is an indispensable treasure. A complete, comprehensive and authoritative collection of the greatest recordings in country music – on records of exceptional fidelity.

The collection may be acquired only by direct subscription to The Franklin Mint Record Society, Franklin Center, Pennsylvania 19091. Subscriptions entered now will be accepted at the original issue price of just $9.75, plus $1.75 for shipping and handling, for each record. This price will be guaranteed for the entire series. Please note that the attached application is valid only if postmarked by March 31, 1981.





The Heirs of Disaster

The currents of change are obliging the people of a Mexican village to rethink their concept of the realm of the possible

By John L. Gwaltney

I remember the Mexican village of San Pedro Yolox when I left it in 1964 as preeminently civil, predominantly poor, and generally resigned to, but not content with, an astounding array of recurrent environmental trauma. "We are poor here so we drink our herb tea, burn our candles, make our vows, and hope for a miracle." The seventeen years that have intervened between the termination of my original fieldwork and a recent return visit to the Sierra Juárez have witnessed massive, multifarious change for San Pedro. As always the torrent of change has proved to be an intermittent stream. Many things remain what they were for all that innovation, but many others are profoundly, irrevocably altered.

Margaret Mead was one of the few practical, positive thinkers I have ever known. It was her lively mind and common sense that were instrumental in first placing me in the remote village of San Pedro Yolox, high in the eastern Sierra Madre. Eighteen years ago the proper intellectual disposition of a blind, black graduate student represented even more of a challenge to the imagination and humanity of senior scholars than it does now. The idea of sending a blind ethnologist to study the role and expectation of blindness in a village in the heart of the New World's onchocerciasis (river blindness) zone was Mead's response to that challenge.

So in 1963, while still acquiring "sierra legs," I trudged into San Pedro Yolox (at that time some three hours of hard walking from the nearest vehicular road), ready to begin a study of cultural accommodation to blindness and other environmental trauma in that Chinantec- and Spanish-speaking Sierra Juárez municipality.

Politically, San Pedro Yolox is a

The author, after an absence of seventeen years, returns to the village of San Pedro Yolox. Judith Gwaltney

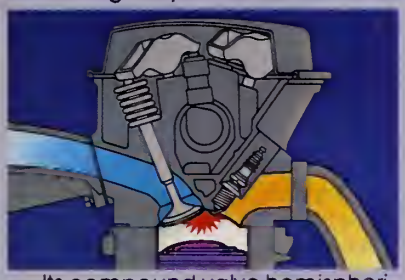


FORD ESCORT. BUILT TO TAKE ON THE WORLD... AND DOING IT.

Outselling every import car line.

When this ad went to press, the American-built Ford Escort was outselling every import car line.†

And no wonder: Ford engineers worldwide teamed up to create this technologically advanced car.



Its compound valve hemispherical head engine gives you high mileage combined with power for freeway driving.

The manual transmission has a 4th gear overdrive standard. A new split-torque automatic is available.

The body design is as aerodynamic as some sports cars. Special steel, high-strength steel, reduces weight without sacrificing solidity.

Result: the compact Escort has better gas mileage ratings than subcompacts like VW Rabbit, Honda Accord, Toyota Corolla Hatchback—and, based on EPA Volume Index, more interior room, too.

44 EST HWY* **30** EPA EST MPG*

*Applies only to sedan without power steering or A/C. For comparison. Your mileage may differ depending on speed, distance, weather. Actual hwy mileage and Calif. ratings lower. Excludes diesels.



What about handling?

Front-wheel drive gives you traction for snow and wet roads. All-season steel-belted radials are standard.

Four-wheel independent suspension smooths the ride, grips the road. And for precise handling, there's rack-and-pinion steering.

Engineered to keep your driving costs down.

Escort has a chassis lubricated for life, 30,000 mile spark plugs, self-adjusting brakes and clutch, and the body is cathodically electrocoated to fight rust.

Most Escort models carry the lowest premium available from Allstate Insurance for any 1981 domestic car under their make and model rating program.

There's a lot more to know about Escort, and your Ford dealer is ready to help you do it. And, whether you buy or lease, don't forget to ask about Ford's Extended Service Plan.

THE NEW WORLD CAR.



†Based on comparison of manufacturers' U.S. retail deliveries of individual car lines.



Enter the world of Questers nature tours.

When you travel with Questers, you have the advantage of our knowledge of the travel world And our experience of the natural world We are travel professionals And our only tour program is Worldwide Nature Tours. You get reliable arrangements and expertly planned itineraries

Under the leadership of an accompanying naturalist, we search out the plants and animals, birds and flowers rain forests, mountains, and tundra seashores, lakes, and swamps of the regions we visit. At the same time, we explore the more usual attractions in touring—the cities, archaeological sites, and people.

Where can you go with Questers? Virtually anywhere in the world The current Directory of Worldwide Nature Tours describes 32 tours varying from 9 to 30 days Following is a representative listing:

Worldwide Nature Tours
1981 Departures (Partial Listing)

The Americas

Everglades: 11 days, Mar. 26 & Nov 5 • Hawaii: 15 days, Feb. 15, Apr. 12, July 12, Oct. 11 & Dec. 20 • Alaska: 17 days, June 6 & 20, July 4, 11 & 25 & Aug. 8 • Newfoundland: 16 days, June 14 • Baja California: 11 days, Apr. 17 & Oct. 16 • Costa Rica & Panama: 16 days, Feb. 14, Nov 21 & Dec. 19 • The Amazon: 16 days, Jan. 19, May 11, July 6, Aug 10, Oct. 12 & Nov 16 • Peru: 23 days, Apr 4, July 18 & Nov. 7 • Ecuador & Galapagos: 15 days, Feb. 5 & 26, Apr 9, July 2, Aug 13 & Oct. 15 • Trinidad & Tobago: 11 days, Mar 9 & Nov 9.

Europe

Iceland: 16 days, June 12, July 3 & Aug. 7 • Islands & Highlands of Scotland: 23 days, May 29, July 10 & Aug. 21 • Spain: 18 days, Apr. 17 & Sept. 4

Asia and Africa

Indonesia: 24 days, July 14 & Sept. 8 • The Himalayas: 25 days, Mar. 19 & Oct. 8 • India: 21 days, Jan. 31 & Oct. 31 • Sri Lanka: 18 days, Feb. 19 & Nov. 19 • Kenya: 23 days, Feb. 5, July 23 & Oct. 22.

Oceania and Australasia

Australia & New Zealand: 30 days, Jan. 31 & Sept. 19 • New Zealand & the Milford Track: 22 days, Feb. 20 & Nov. 13

For a complimentary copy of the newest Directory of Worldwide Nature Tours outlining the entire program, write to Questers or see your Travel Agent. If you are interested in a specific tour, request the Detailed Itinerary. Exploratory expeditions and special tours are announced from time to time in our newsletter Nature Tour Notes, *sent free to all on our mailing list.*



QUESTERS

Questers Tours & Travel, Inc.
Dept. NH371, 257 Park Avenue South
New York, NY 10010 • (212) 673-3120

subdivision of the Oaxacan north escarpment district of Ixtlán. The centrally located village of San Pedro is the administrative center of the entire municipality of the same name. Culturally, Yolox is a distinct part of the western Chinantla, the traditional center of Chinantec cultures.

The Chinantla is a broken cross section of the Sierra Madre Oriental and the municipality of San Pedro Yolox displays the same ample microgeographical range that is characteristic of Mesoamerica in general. The village of Yolox, together with its environing hamlets (*ranchos* or *rancherías*), encompasses alpine, temperate, semitropical, and tropical zones. Elevations in the municipality range from 2,300 feet above sea level at its lowest extremity in Rancho Esperanza to more than 6,500 feet above sea level in the administrative center.

Once the arduous process of developing sierra legs is well enough advanced, it is possible to walk from the cold uplands above the central village, where the brisk air is filled with the scent of pines and cedars, to the tropical downcountry, where coffee, bananas, and lemon trees flourish. The elevated downslope portions of the municipality are by far the most productive. Coffee, which is the only cash crop, bananas, and vital building barks and vines are produced or gathered only in this region. However, the daughter streams of the Papaloapan River system that traverse this two-crop maize land are the breeding places of the several species of simuliids that are the intermediate hosts of the larva of *Onchocerca volvulus*. Larvae transmitted by the bite of these simuliids may mature and reproduce in human hosts. Successful *Onchocerca* colonies expand along such connective tissue as the optic nerve. Sustained infestation induces onchocerciasis, skin lesions, and an alteration in the color of the skin known locally as *mal morado* (the "purple sickness"). Transgenerational exposure to onchocerciasis has occasioned an abnormally high incidence of both economic and total blindness among Yoleños.

The Chinantec-speaking peoples are heir to a lengthy heritage of conquest. The expanding Aztecan state was industriously taxing and coercing them as the master mariners of Iberia were creeping westward. The conquistadors and the Dominicans forced them to gather hard by the marginal mountain wall, the better to watch and convert them. This legacy of subordination is manifest in the official name of the village. The Mexica (Aztecs) called it Yoloxochitlán, and the Spaniards called it San Pedro. It appears on maps as San Pedro Yolox, but its Chinantec inhabitants also call it Noo.

Onchocerciasis is perhaps the most spectacular of numerous disasters that make life hard for Yoleños. Months of fierce rain and hurricanes, the yawning earth and the serpent's mouth all take their mortal toll. This long history of subjugation and environmental trauma tends to make Yoleños publicly civil but privately wary before God and the powerful stranger.

In 1963 all cargo going into or leaving the village was carried on the backs of mules, horses, or men, but for all its remoteness, San Pedro was not isolated. The few radios of the municipality had conveyed the bad tidings of Mississippi and Alabama racism. I was assured by the municipal secretary in his welcoming address that I need have no fear of that particular kind of barbarism from Yoleños. Big-state Mexican ideas about health, education, and culture were being transmitted by visiting doctors, nurses, and teachers. A squad of federal soldiers was stationed there to prevent Yoleños or their neighbors from breaking the *pax Mexicana* by a rekindling of the traditional, bloody fighting for land. The Mexican government with its commitment to the modern notion of progress had launched a medical campaign against river blindness and other endemic diseases. In 1963 ideas such as progress and the germ theory of disease were among the abstractions that many Yoleños weighed respectfully in their scanty leisure. There were three kinds of economic status among the Yolox Chinantec. A very small group of families had shops and/or landholdings providing them with enough to eat of the foods that appeared in everybody's good dream diet. An overwhelming majority made wry jokes about their very real poverty, their fleas, and their frequent recourse to low-prestige foods. Turkey, chicken, and other prestigious animal protein were esteemed condiments for Yoleños, used most lavishly to add zest to fiesta dishes. A third group, a considerable number of families, were obliged by their extreme poverty to fast more often and resort even more frequently to the low-prestige foods

Choose one of these five sets and save up to $216.15

You simply agree to buy 4 books within the next two years as a member of the Book-of-the-Month Club.*



The Compact Edition of
The Oxford English Dictionary

The "most complete, most scholarly dictionary of the English language"—*The Christian Science Monitor.* Through photo-reduction, the original 13-volume set has been reproduced in this two-volume Compact Edition. Magnifying glass included.

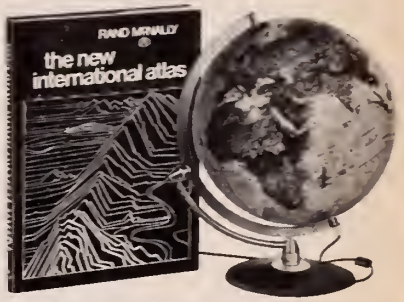
$125.00	Publisher's price
$ 19.95	Book-of-the-Month Club price
$105.05	Your savings



The Complete
Beethoven Nine Symphonies

Sir Georg Solti conducts the Chicago Symphony in this nine-record set, hailed by the *San Francisco Sunday Examiner & Chronicle* as "one of the two or three great recording ventures of the century," and by *Time* as "a glorious musical combustion."

$71.82	List price
$10.00	Book-of-the-Month Club price
$61.82	Your savings



The New International Rand McNally Atlas
and the Hammond Geo-Scan Globe

This new, enlarged (11¾" x 15½") atlas features 323 pages of distinctive, full-color maps and charts and a 160,000-place index. The Hammond Geo-Scan Globe is 16" high, 12¼" in diameter. Interior light illuminates world's political boundaries.

$130.00	Total price for both
$ 27.50	Book-of-the-Month Club price
$102.50	Your savings



The Story of Civilization by Will and Ariel Durant

For more than a generation, Will and Ariel Durant have been tracing the continuity of our history—economic and political organization, science and art, religions, philosophies, customs and manners—to show the foundations of society today. Now complete, the Durants' 11-volume masterwork is history come alive. The enormous work covers ancient and modern civilization, including Oriental as well as Western history. With clarity and authority the Durants illuminate "the steps by which man passed from barbarism to civilization." This set is a magnificent centerpiece for any home library, and one of the most useful sources of knowledge that the modern reader can possess.

$241.10	Publisher's prices total
$ 24.95	Book-of-the-Month Club price
$216.15	Your savings



The Encyclopedia of Philosophy

The most comprehensive encyclopedia of philosophy ever published, this set traces ancient, medieval, modern, Eastern and Western thought. An essential and rewarding reference source for home libraries.

$150.00*	Publisher's price
$ 19.95	Book-of-the-Month Club price
$130.05	Your savings

*While the publisher's price has recently risen from $125 to $150, our special price remains the same

Prices shown are publishers' U.S. prices. Outside the U.S., prices are generally somewhat higher.

Facts About Membership. You receive the *Book-of-the-Month Club News** 15 times a year (about every 3½ weeks). Each issue reviews a *Main Selection* plus scores of Alternates. If you want the *Main Selection* do nothing. It will be shipped to you automatically. If you want one or more Alternate books—or no book at all—indicate your decision on the reply form always enclosed and return it by the date specified. *Return Privilege:* If the *News* is delayed and you receive the *Main Selection* without having had 10 days to notify us, you may return it for credit at our expense. *Cancellations:* Membership may be discontinued, by either you or the Club, at any time after you have purchased 4 additional books.

Book-of-the-Month Club, Inc., Camp Hill, Pennsylvania 17012 A113-3

Please enroll me as a member of Book-of-the-Month Club and send me the work I have checked below, billing me for the appropriate amount, plus shipping and handling charges. I agree to buy 4 books during the next two years. A shipping and handling charge is added to each shipment.

CHECK ONE BOX ONLY

- ☐ 904. Beethoven Symphonies $10
- ☐ 912. Compact OED $19.95
- ☐ 913. The Story of Civ. $24.95
- ☐ 917. Ency. of Philosophy $19.95
- ☐ 926. McNally/ Hammond Set $27.50

Mr.
Mrs. _____ 1-61
Miss
(Please print plainly)

Address _____ Apt. _____

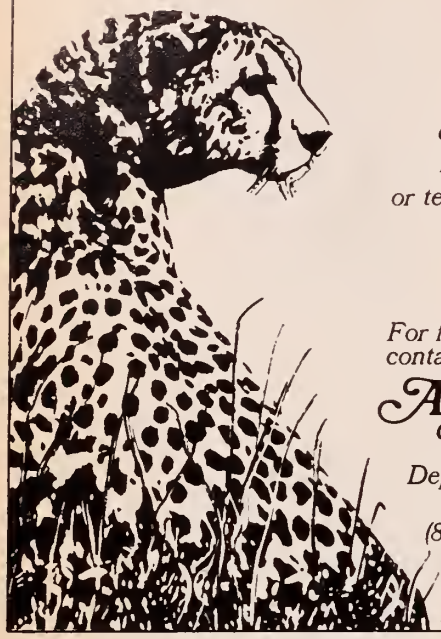
City _____

State _____ Zip _____

BOOK-OF-THE-MONTH CLUB®

Go Wild...

And let Abercrombie & Kent treat you to our twenty years of African Wildlife expertise. We cover the continent—The Nile, Kilimanjaro, Kenya's game parks, Tanzania's Serengeti, The Seychelles, literally from Cairo to the Cape. And we'll put together any type of program—from prepackaged tours to tailormade super-deluxe safaris. Choose minibus, four-wheel drive or wing, lodge or tented camp or any combination.



For further information and brochures contact your travel agent, or

Abercrombie & Kent International, Inc.

Dept. NH1 · 1000 Oak Brook Road
Oak Brook, Illinois 60521
(800) 323-7308 · (312) 887-7766

CHICAGO · NEW YORK · LOS ANGELES
LONDON · NAIROBI · JOHANNESBURG · CAIRO



The centuries have been kind to us.

Oregon has been graced with abundant wildlife and some of the most extraordinary natural beauty in the world. We've been able to grow wisely, protecting the land and clear waters of our state. The reward for that care is evident today, and you can share it this vacation. Our 64-page, full-color, book on Oregon will give you all the facts. It's free. Call us for the book and then come visit. You'll find out how kind Oregon will be to you.

PHONE TOLL FREE for your guide. 1-800-547-7842
(outside Oregon) Or write: Oregon Travel Information, Room AT 200, Department of Transportation, Salem, OR 97310.



Nature & Cultural Expeditions

Combine adventure, discovery, learning and vacation on expeditions to unique environments worldwide!

In 1981, join NEI in Baja California • Nepal Australia • New Zealand • Ecuador & Peru New Guinea • Galapagos • Sea of Cortez Hawaii • Tanzania & Kilimanjaro • Alaska Peru & Easter Island • Bhutan • Scotland Patagonia & the Falklands • Canyonlands Polynesia • Kashmir & Ladakh • Costa Rica Yucatan & Guatemala • Indian Country Kenya • Japan & Others Worldwide!

Leisurely expeditions for groups of eight to twenty led by experts in natural history or anthropology. Superb photography.

Nature Expeditions International 599 College Ave. • Dept. NG Palo Alto, CA 94306 (415) 494-6572

that figured largely in bad dream diets. This group was larger by far than the group with the most to eat.

In 1963 this pervasive poverty was reflected in the desultory attendance at the three-room elementary school of the village. The region of Yolox has excited the aesthetic admiration of many a foreign traveler, but those who must "pull bread from among these stumps and stones" long for the exalting of every valley and the lowering of every mountain and hill. When they say, "Our land is very ugly, nothing but mountains and trees," they mean that nine-tenths of it is impervious to even their arduous, complicated agricultural exertions. Those exertions and their prime end, to eat and, hence, to live, took precedence over education, the germ theory of disease, and the abstract imperatives of big-state Mexican culture.

Their complex agricultural regime scatters Yoleños over portions of every one of the microgeographical niches of their municipality. Only one Yoleño in seven belonged to a family that did not possess two dwellings, one in the *cabezera*, or municipal seat, and another, less substantial house of banana bark or some other tropical building material for use when the agricultural system mandated migration to the tropical *ranchos*. Fire-agriculture schedules varied in the almost vertical fields of their cold temperate and hot wet tropical zones. The loss of the labor of a child capable of agricultural work or the maintenance of a very young child in the centrally located village, site of the only school, represented a formidable strain upon the minimal resources of most Yoleños.

An abnormally large blind population was a serious burden upon the slender resources of many Yolox Chinantec. At least four out of ten Yoleños were related by ties of consanguinity or ritual kinship to a blind person. In 1963 at least 21 of the 963 Yoleños were blind, and most of these were obliged to ascend and descend their roller coaster trails driven by the same imperatives of hunger that goaded their sighted paisanos. Blindness was firmly established among the distressingly ample roster of traumatic customary expectations. Some villagers ate mescaline-bearing mushrooms or did the divinations that are done with various kinds of beans or maize grains to find out why life was unusually hard. But a hard,

chancy existence was quite reasonably considered normal, given their realities.

Divination or sorcery may explain or remedy misfortune occasioned by the malice of one's paisanos in this world or the next. Afflictions of God are not thought of as yielding to any form of human magic. Much of the Chinantec past has inclined them to roll with the political or supernatural punch. They are valiant in the defense of their sacred land and honored families, but it is a theological tenet with them that illimitable might is the sovereign aspect of God's nature. There was a pronounced tendency to think of the blind as His victims. Yoleños invariably dealt courteously and practically with blind people. Extravillage mendicancy was regarded as a necessity to which little stigma was attached. Blind Yoleño beggars accompanied by child guides ventured as far as Mexico City or Veracruz, although most begging expeditions were to neighboring villages. The easy, transgenerational deference that characterized the interaction of children as young as four or five with the middle-aged or elderly blind was a part of a general Yoleño tradition of practical civil identification with the handicapped. Most people defined a friend quite literally as "someone who feels your grief," and children walked with the blind "out of love." Without any significant exception, Chinantec of all generations extended the same civility to me. I was certainly the wealthiest and most technically encumbered blind person they had ever seen. One elderly woman saw an element of ill-defined menace in my metal canes, but most people were politely but openly curious about my Braillewriter and Braille watch. The sight of a blind person reading or typing was new to them, but most villagers were more interested than impressed by my devices. Their prime requirement is for a technology that minimizes drudgery and increases the yield of their grudging slopes.

The sense of awesome autonomy that often clings to technology in a machine culture was only nascent in Yolox in 1963. Humanity was still the measure of most things. I had to travel in their country in much the same way as any other blind person. My wealth made it possible for me to ride more often and hire the time and labor of people for my special purposes, but a child of eleven could see that my

SOUNDS THAT SOOTHE.

The Marsona sound conditioner generates the primal sounds of nature—the surf, the rain, the rhythmic gushes of a waterfall. And these sounds aren't recorded— but synthesized— with the use of advanced solid state electronics.

Hospitals use sound conditioners like the Marsona to relax patients in the coronary and respiratory care sections. Controlled laboratory tests at a university sleep lab indicated that sound conditioned sleepers got to sleep quicker, slept longer and received about 50% more Delta (stage 4) deep sleep.



Marsona's all-electronic design offers several advantages over earlier electro-mechanical models: more types of sounds (2 surf, rainfall, waterfall). There are no moving parts, no tapes, nothing to wear out. And it uses less electricity than a small night light.

And you can fine tune sounds to exactly your likes; from a mere whisper all the way up to a strong masking sound. With the surf you can even vary the rhythm from slow to fast to random.

The Marsona 1200 uses 'white noise'—long recognized by scientists for its ability to mask out unwanted noise that interferes with sleep, relaxation or work. We offer you the Marsona 1200 for a full two week money-back trial. One year warranty.

ORDER TOLL FREE

Order product #255. Credit card holders may use our toll-free number. Or send check for $129 plus $3.50 delivery (in California, add $7.74 sales tax). Please mention this magazine.

800 227-3436
In California 800 622-0733

THE SHARPER IMAGE™
260 California St., San Francisco, CA 94111
(415) 788-8880 ©1980 The Sharper Image

The Aviator Shirt.

Authentic. Manufactured by Van Heusen—the people who supply most of America's leading airlines. Features button-through flap pockets, one with pencil slot. And epaulets, naturally. Collar looks neat and correct worn open or with tie. Extra-long tail. This special edition Van Heusen shirt is cut for comfortable fit, and smartly tailored of military-weight poplin. The 65% Dacron® polyester/35% combed cotton fabric delivers the comfort you want plus the permanent press convenience you demand. Choose khaki, blue or white. Short sleeves $16. Long sleeves $17.

* DuPont registered trademark



Size Chart for the Aviator Shirt

Neck Size	14½	15, 15½, 16, 16½, 17	17½
Sleeve Length	Med. (32/33)	Med. (32/33) or Long (34/35)	Long (34/35)
When ordering, indicate sleeve length by using letters M or L.			

Neck sizes for short sleeve shirts: 14½ to 17½

LONG SLEEVE @ $17

Qty.	Color	Neck Size	Sleeve Length M or L
	White (19-567)		
	Blue (19-568)		
	Khaki (19-569)		

SHORT SLEEVE @ $16

Qty	Color	Neck Size
	White (19-560)	
	Blue (19-561)	
	Khaki (19-562)	

Add $2 per order for shipping and handling, plus local taxes where applicable
Make checks payable to Corporate Markets Company
Mail your order...or call toll free (800) 528-6050

☐ Personal Check or Money Order ☐ Visa ☐ American Express ☐ Master Charge

Card # _____ Exp Month _____ Year _____

☐ Mr. ☐ Mrs. ☐ Ms. _____

Address _____

City _____ State _____ Zip _____

CORPORATE MARKETS COMPANY
281 Centennial Avenue, Piscataway, N.J. 08854

ANR

In fine porcelain . . . decorated with a border of pure 24kt gold

The Woodland Year

by Peter Barrett



Fawns in the June Meadow

© 1981 FP

Plates shown smaller than actual size of 9⅛" diameter.

ADVANCE SUBSCRIPTION APPLICATION

The Woodland Year

Valid only if postmarked by March 31, 1981
Limit: One collection per person

Franklin Porcelain
Franklin Center, Pennsylvania 19091

Please enter my subscription for the special Signature Edition of "The Woodland Year," consisting of twelve collector's plates to be crafted for me in fine porcelain, and decorated with a border of pure 24 karat gold.

I need send no money now. The plates are to be sent to me at the rate of one every *other* month. I will be billed for each plate in two equal monthly installments of $27.50* each, the first installment in advance of shipment.

**Plus my state sales tax*

Signature_____
ALL APPLICATIONS ARE SUBJECT TO ACCEPTANCE

Mr.
Mrs.
Miss _____
PLEASE PRINT CLEARLY

Address _____

City_____

State, Zip_____

25

© 1981 FP

A



NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

WS

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO 1 FRANKLIN CENTER, PENNSYLVANIA

POSTAGE WILL BE PAID BY ADDRESSEE

FRANKLIN PORCELAIN
Franklin Center, Pennsylvania 19063

B

The changing seasons . . . and the delightful creatures of the forests. Portrayed in a collection of twelve charming collector's plates . . . one for each month of the woodland year.

Limited Signature Edition. Advance Subscription Deadline: March 31, 1981

The beauty and grace of a young deer frolicking in the summer meadow . . . the delight of a baby raccoon being startled by a tiny green frog . . . the charm of two chipmunks sharing their food with a little bird . . . such scenes from nature have a very special fascination for us all. To be able to capture these qualities in visual form is a unique gift – and the renowned English painter Peter Barrett has that rare gift in abundance.

Because Barrett is a trained naturalist as well as an artist, he is able to portray in his work not only the personality of nature's most captivating creatures – but also their distinctive features in realistic detail.

This distinguished wildlife artist will now undertake a uniquely challenging assignment. He will create a series of new works of art *exclusively* for a collection of twelve porcelain plates – plates that will depict woodland animals at play throughout the twelve months of the year.

Each of these works by Peter Barrett will be created for "The Woodland Year" porcelain plate collection, to be issued by Franklin Porcelain. And the first edition of this collection will be a special, limited "Signature Edition."

Each plate portrays a different animal . . . during a different month of the year

To capture the beauty of these woodland



The Friendly Chipmunks in August

scenes, Peter Barrett will depict each animal in a different natural setting . . . and during a different month of the year. And



Squirreling for Nuts in January

each delightful animal – the raccoon for April, the deer for June, the badger for October – symbolizes especially well that particular time of the year.

The January plate, for example, portrays two Grey Squirrels digging up acorns on a snowy winter's day. The May plate depicts a baby fox startled by the sudden appearance of a butterfly in the tall grass. The November plate shows an American Marten perched in a pine branch – a moment after he has mischievously disturbed a Red-Breasted Crossbill . . .

Every one of the twelve plates that make up the collection has a charm about it that is irresistible. Because no detail, no matter how small or subtle, escapes the eye of Peter Barrett.

A unique way to depict nature's most delightful creatures

Consummate artist that he is, Peter Barrett is always seeking ways to make his art different and original. And here he has found a most ingenious one. He has portrayed each scene as though it were being viewed secretly, without the animals knowing you were there. Thus, as you look at the plate, you have the illusion of having peered through an opening in the forest – and suddenly come upon this delightful scene! It's a technique which Barrett uses in the most winning manner . . . and each of the twelve works of art, therefore, becomes a new and pleasant surprise.

In order to capture the art of Peter Barrett in the most appealing manner, each plate will measure 9⅛ inches in diameter. Moreover, each of these lovely woodland plates will be decorated with a border of *pure 24 karat gold*. Franklin Porcelain has entrusted the creation of the plates for this distinguished collection to its affiliate, Franklin Porcelain of Japan.

Signature Edition available for a limited time

The Signature Edition of "The Woodland Year" by Peter Barrett will be distinctive because it is the *only* edition of this collection that will bear the signature of the artist on each plate.

In the tradition of fine porcelain, the plates in this desirable Signature Edition will be issued *only* during a single year – and will never be made available again. Thus, the total number of sets to be issued in the Signature Edition will be forever limited to the exact number of original subscriptions entered by the end of 1981, plus one set for the artist and one for the archives of Franklin Porcelain.

The collection of twelve plates will be sent to subscribers at the rate of one every *other* month, and the issue price for each plate is just $55, payable in two convenient



The Butterfly Chase in May

monthly installments of $27.50 each. This price is *guaranteed* to subscribers for each of the twelve plates in the collection, regardless of any rise in costs during the entire subscription period.

To enter your subscription for the Signature Edition of "The Woodland Year" – and begin to build one of the most beautiful collections in fine porcelain – mail your application to Franklin Porcelain, Franklin Center, Pa. 19091, by March 31, 1981.

Surprising fact.

INFLATION RATE UP 64.86%*
(Consumer Price Index)

500 STOCKS UP 163.83%**
(Standard & Poor's)

DREYFUS NUMBER NINE UP 458.29%**

While many investors have overlooked common stock mutual funds as an effective inflation hedge, the Dreyfus Number Nine Fund has advanced over the Consumer Price Index by more than 6 times over the past 6 years, and has outperformed Standard & Poor's 500 Stocks during this period. Number Nine is particularly alert to relatively small companies, both domestic and foreign. We invite you to find out more about the Dreyfus Number Nine Fund, a no load common stock fund. Mail coupon or call toll free.

*January 1, 1975–November 30, 1980
**Lipper Analytical Services, Inc., January 1, 1975–December 31, 1980

Dreyfus Number Nine

For more complete information, including management fee charges and expenses, obtain a prospectus by sending this coupon. Read it carefully before you invest or send money.

Name _____

Address _____

City _____

State _____ Zip _____

226E100 NN240

Post Office Box 600
Middlesex, N.J. 08846

FOR A PROSPECTUS

Call toll free, day or night, 7 days a week

1-800-345-8501
Extension 419

In Pennsylvania
1-800-662-5180
Extension 419

new technology, except for the remote arcana of pursuits ethnological, was essentially sounding brass in his land. "You have a finger-writing machine and a finger watch and you give many little fiestas, but would it not be much better for you if your eyes were not clouded?"

The multilevel campaign of the Mexican government to integrate Chinantec and other indigenous ethnic communities into the national culture has intensified since 1964. The influence of what the Mexican media often call "that powerful gentleman, Don Petroleo," has probably caused a geometric acceleration of the scope and magnitude of this effort.

Seventeen years ago an elderly blind musician and pungent raconteur told me that "a dry trail would bring you anything." Now the widest of Yoleño trails has been converted into a dirt road that can carry the hardiest of motor vehicles into the administrative and commercial heart of the high village even in the time of summer rain, despite the several arroyos it must cross. Almost a half dozen of those who eat best own motorized vehicles.

The twenty-four men who take their seats and ceremonial staffs after All Saints' Day to govern the municipality meet in a new Municipal Palace. In this imposing, soon to be two-story administrative "House of Authority" there is very serious talk of driving a road through to the tropical downslope hamlets. At this writing, neither the internal combustion engine nor things electric are present in these *ranchos*. Their relative inaccessibility makes of these hamlets a kind of refuge area where the shadow of that insolence that often characterizes mountaineers still lingers. When the region's agricultural wealth is transportable by mechanical rather than animal or human exertion, when the tumpline and muleback have lost their dominion, the pace of innovation and integration will quicken definitively.

The three-room elementary school has been replaced by a thirteen-room educational plant with dormitory, latrines, and facilities for providing meals. Substantially freed from the often prohibitive costs of maintaining a very young child in the high village, many parents are willing, indeed anxious, to comply with compulsory education. For these children there will not be the same inferences of a necessary separation between education and culture because now Chinantec,

The start of a fine home library



Let us send you, for the token price of only $1 each, three books that have served as cornerstones in many a fine home library.

The complete works of Shakespeare

This beautiful 1300-page volume contains every word Shakespeare ever wrote. All 37 of his comedies, tragedies, and historical dramas including Hamlet, Romeo and Juliet, Macbeth, etc. Also all of his poems and sonnets.

The works of Kipling

Actually eight books in one. A complete novel and 139 stories, ballads and verses loved the world over, including Mandalay, Gunga Din, The Phantom Rickshaw, etc.

The works of De Maupassant

128 matchless tales by the acknowledged master of the short story. Every story complete and unexpurgated: The Diamond Necklace, A Piece of String, The Will, etc.

Each volume is clothed in a handsomely-tooled binding of antique ecru with both the elegant look and feel of leather.

You will enjoy reading these books, just as millions before you have. Your friends will admire them, perhaps even envy you for owning them. And your children will gain a real advantage with books like these always close at hand.

We offer you three books of this calibre for only $1 each to introduce you to our new Golden Giants Series. We think you will be impressed. And we hope you will want to own others in the Series, as they become available, including:

Hugo. 36 complete works including Hunchback of Notre Dame, A Woman of the Streets, The Souls.

Stevenson. 39 novels, stories, poems. Treasure Island, Dr. Jekyll and Mr. Hyde, Kidnaped, etc.

Doyle. All the best of Sherlock Holmes—The Sign of The Four, Red-Headed League, plus other works.

Poe. 91 works: Annabel Lee, The Raven, The Gold Bug, Murders in the Rue Morgue, etc.

The full series will also include the works of Cellini, Wilde, Ibsen, Browning, Longfellow, Emerson, Dostoevsky, Byron and many others.

Normally, you would expect to pay $12 each or more for deluxe editions of books like these. But our direct-to-the-public method of book distribution (which we have specialized in for over 50 years) lets us make these volumes available for only $7.89 each, plus shipping.

Send no money now. Simply mail coupon to get your first three volumes for only $1 each, plus shipping, and to reserve the privilege of examining future volumes as they come from the press.

You will receive advance description of all upcoming volumes. You may reject any book before or after you receive it. And you may cancel your reservation any time you wish.

Mail coupon to: Black's Readers Service, Roslyn, New York 11576.

Regularly $23.67. Now only $1 each.

Black's Readers Service

ROSLYN, NEW YORK 11576

Please enroll me as a subscriber and send me at once SHAKESPEARE, KIPLING and DE MAUPASSANT. I enclose *no money now*. After a week's examination, I will either keep my books and pay $3 (plus shipping) or return them.

Also reserve for me additional volumes in the Golden Giants of Literature Series. As a subscriber, I will get advance descriptions of future volumes. For each volume I choose, I will pay just $7.89 (plus shipping). I may return any book, for full credit within 21 days and I may cancel my reservation at any time.

MR. MRS. MS. _____
Please print plainly 1-OP

ADDRESS _____

CITY & STATE _____ ZIP _____

Note: Subscribers accepted in U. S. A. and Canada only. Offer slightly different in Canada.

G02D3J

L.L.Bean®
Outdoor Sporting Specialties



FREE Spring Catalog

Fully illustrated. Features quality apparel and footwear for men, women and children; fishing, hiking, camping and canoeing gear. For 69 years L. L. Bean has offered practical and functional merchandise at reasonable prices. Many items of our own manufacture. All fully guaranteed.

☐ SEND FREE CATALOG

Name _____

Address _____

City _____

State_____ Zip_____

L. L. Bean, Inc.
711 Casco St., Freeport, ME 04033

Better Than Jogging



NordicTrack

Jarless Total Body Cardiovascular Exerciser Duplicates X-C Skiing for the Best Motion in Fitness

This revolutionary new exerciser duplicates the smooth, rhythmic, total body motion of X-C skiing for the most effective cardiovascular exercise obtainable. Uniformly exercises more muscles than any other exercise device. Makes high heart rates easy to obtain and keeps more muscles in tone. Also highly effective for weight reduction.

Completely jarless natural motion does not cause joint and back problems as in jogging or running. Arm and leg resistances are separately adjustable for maximum effectiveness. The NordicTrack uses no motors and folds compactly for convenience. Used in homes, businesses, and institutions. Our customers include Xerox Corporation, US Army, Penn State U and the YMCA.

For more info, call or write
PSI 124 L Columbia ct. Chaska, MN 55318
toll free 1-800-328-5888, MN. 612-448-6987

the rich, tonal, subtle, synonym-laden language of their homes, is spoken by fully half the staff of the new boarding school. Teachers are fluent in both Chinantec and Spanish, and this vital bilingualism is permitted and even encouraged in the classroom by the Instituto Nacional Indigenista, under the enlightened directorship of Dr. Salomón Nahmad. The Instituto is a Mexican national agency roughly equivalent to the United States Bureau of Indian Affairs.

The roster of customary calamities is being reduced. There are far fewer blind people in San Pedro now. The sardonic bandsman is no longer playing with the orchestras of this world. The lady who suspected that my steel canes might double as magical wands has gone on to the next world, as have about a dozen other elderly blind people.

There are no more assiduous soldiers in the ranks of progress than the brigades or paramedical teams of the Campaign Against Onchocerciasis. The effectiveness of their decades of therapeutic effort is plainly manifest in the drastically declining infection rate. Public education, the administration of antifilarial medications to everyone over the age of five, and the surgical excision of the nodules containing the adult filariae have eliminated blindness as a transgenerational expectation. The ranks of the blind are thinning because no new generation of severely infected men and women is emerging to fill them. Begging is not, even now, a thing of the past, but it is a much more precarious and much less satisfying activity than it was seventeen years ago. The resourceful, sighted, traditional junior partners of these adventurous secular pilgrimages are being sent to the new boarding school. Now those whose desire to relieve their penury or tedium is strong enough to impel them to take to the road must rely upon older, less trustworthy and less tractable guides who are often not fellow villagers. Begging is ultimately irreconcilable with the concept of progress, so increasingly, mendicancy is becoming that which Yoleño authority and public opinion will still permit but not approve.

The rich, strange mix of change is obliging the Yolox Chinantec to rethink their concept of the realm of the possible. "Life is easier and life is harder now." Most villagers have access to electricity but few use it, being too often away and occupied in the *ranchos*. Twenty-two public watertaps bring the mountain water closer to some of the high-village inhabitants and preclude the arduous necessity of hand carrying it all from the distant spring. The *jacal*, that most insubstantial of houses, has been relegated to the edges of the most remote of the high-village barrios and the dependent hamlets. Concrete and aluminum sheeting are increasingly preferred building materials, gradually forcing the traditional adobe out of use. Young men and women have learned new trades from the Cultural Mission of the Mexican government. The hand-hewn, often carved stools are rapidly being replaced by chairs fashioned by Yoleño carpenters, and the new, government-mandated latrines are being built by local masons. A number of seamstresses and human and veterinary paramedical specialists have been trained, but as yet these are not full-time occupations. A number of not altogether unsordid boons of progress have put in their appearance. Junk food is infinitely more available and that junkiest of junk foods, the airy stuff that often passes for bread in more progressive climes, is seriously competing with locally made wheat and corn breads, including even the ubiquitous tortilla. Television has made a very slight but palpable portentous hit in Yolox.

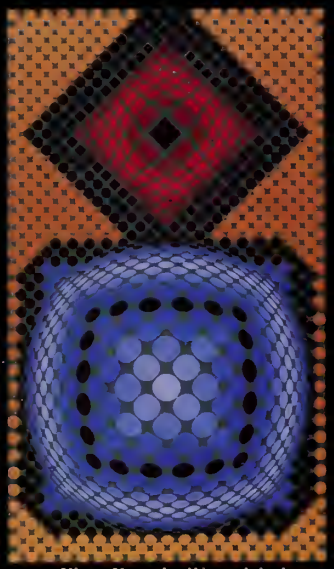
Rampant inflation has accompanied the increased reliance upon a money economy. The indispensable long machetes, yokes, axes, and palm fiber hats all cost ten times more than they did seventeen years ago. The price of staple and fiesta foods has increased even more. A new government store supplies such staples as beans, rice, maize, and cooking oil, and even some fiesta foods such as sardines, sugar, and cookies at lower prices than those prevailing in the privately owned shops. Since the government store does not extend credit, however, the poorest Yoleños are still locked into the credit regime at the three privately owned stores of the centrally located administrative village.

The earning power of Yoleños has increased at a much slower rate. There are augmented opportunities for those who own coffee trees or those who are willing to leave the municipality to work on distant coffee estates, but the voracious cost of living rapidly devours what they gain by five months of very hard labor.

What your home could have in common with the Met, the Tate, and the Louvre



Claude Weisbuch, *Concerto pour Violins et Lumière*, original lithograph. Edition of 250.



Victor Vasarely, *Mita*, original serigraph. Edition of 125.



Wilbur Streech, *River Moonlight*, original serigraph. Edition of 250.



Jarle Rosseland, *A Cold Day*, original woodcut. Edition of 225.



Nathalie Chabrier *Le Landau*, original lithograph. Edition of 250.



Louis Travert, *Roses Violettes*, original lithograph. Edition of 190.

In your own home, you can exhibit original work by artists who are represented in the world's great museums and galleries.

Artists like Calder. Chagall. Dali. Miró. Picasso. Vasarely.

At the Original Print Collectors Group, we offer moderately priced limited edition prints by these and other well-known artists.

Our offerings include signed original etchings, engravings, lithographs, woodcuts, and silkscreen prints.

Each print we offer is signed and numbered by the artist. Custom-framed. Accompanied by a certificate of authenticity and a full money-back guarantee.

And each print has been chosen not only for its beauty but for its investment value.

(Works by the artists we offer tend to appreciate, sometimes as much as 30% in a single year. Perhaps that's why *The Wall Street Journal*, *Business Week*, *Money*, AP, *Barron's* and UPI have quoted us as an authority on investing in art.)

For more information, send in the coupon. There's no obligation.

You'll find out about the special pleasure of owning original art, instead of just visiting it.

Original print collectors group, Ltd.

215 LEXINGTON AVE., DEPT. NH-28, NEW YORK 10016

PLEASE SEND ME YOUR FREE COLOR CATALOGUE AND LATEST NEWSLETTER.

NAME _____

(PLEASE PRINT)

ADDRESS _____

CITY _____ ST _____ ZIP _____

© 1981 ORIGINAL PRINT COLLECTORS GROUP, LTD.



Judith Gwaltney

Seventeen years ago, beggars were aided by children who walked with the blind "out of love."

Some very basic strands of Chinantec life remain unaltered. Those who eat regularly and well still measure their maize crop by the ton. The large group of very small holders and the landless who secure rights to communal plots still measure the fruit of their exertion by mule loads.

About half the village householders have complied with the legal injunction to build proper latrines. But some are obliged to rent the use of these facilities now that "it is forbidden to sit down outside." The costly, thick rubber boots that people wear when working their hot humid downslope land will trap the fangs of vipers and all other venomous animals. But should these creatures elect to smite you upon the hand, you would still share the fate of the four ladies who died of snakebite in 1964.

The range of the massive wildcats that Yoleños call *tigres* has been restricted by the increased presence of humankind. They have retired farther into the mountains but "if you meet one there without a dog or a gun, you will remain there." The monkeys that live in the most remote parts of the central village and thrive in the tropical forest are safer now. The high cost of ammunition makes hunting game impractical for many.

The new municipal corn mill saves the women of the high village many hours of drudgery. But this new mill, the new road, and all the monumentality of progress have increased *tequio*, the tax of days of communal labor exacted from all able-bodied sons of the pueblo. A few are able to hire others to fulfill this obligation, but most must pay this increasingly burdensome tax out of their own muscle and at the expense of their own personal agricultural schedules.

Even if technology can effect a relenting of their hazardous environment, the quality of existence will not necessarily be improved. Social trauma, alcoholism, malicious and divisive gossip, and the fratricidal strife of factions over land must yield to reason and enlightened self-interest if life is to be really better. But seventeen years ago blindness was attributed to the will of God or even "the luck of each one," and now it is seen as a calamity that is yielding to human intervention. The hard lessons of a traumatic history and life in a merciless motherland have disinclined the wary, intelligent Chinantec to be the first by whom the new is tried. But if progress can make them victors over blindness, what prudent Yoleño can fail to weigh very seriously the prospect of even wider breaches in their wall of customary defensive conservatism.

Traditionally, the Chinantec were reluctant to "carry things to Mexico" and settled their affairs among themselves in juntas and in face-to-face interpersonal and communal consensus. Now they are cognizant of the inevitable encroachment of innovating bureaucracies and more than a little of the old fatalism remains, for not only does God "do as He pleases," but "paper talks." The degree to which the Chinantec will expand their view of the realm of the possible is in no small measure dependent upon the quality of their integration into general Mexican society, a process orchestrated by the powerful stranger.

John L. Gwaltney, professor of anthropology at Syracuse University, is author of Drylongso: A Self-Portrait of Black America *(Random House) and* The Thrice Shy: Cultural Accommodation to Blindness and Other Disasters in a Mexican Community *(Columbia University Press).*



The 80 proof drink with a taste you don't have to acquire.

COINTREAU

Liqueur–France

COINTREAU LIQUEUR, 80 PROOF. RENFIELD IMPORTERS, LTD., NY ©COINTREAU CORP., 1980.

Toxic Tailings and Tolerant Grass

Adapted to mine soils contaminated with heavy metals, a species of grass in Wales provides an opportunity to learn about natural selection—and perhaps land reclamation

by Robert E. Cook

The tailings of abandoned mines hardly seem a fitting place to watch evolution. Vestiges of former excavations, they lie like forgotten scars on the face of the landscape. Rain rapidly drains through the coarse, porous soil, which holds little organic matter and few mineral nutrients. Toxic concentrations of heavy metals—zinc, copper, and lead—contaminate the sediments, rendering the ground water poisonous for most plants. Careful searching across this largely barren surface, however, frequently turns up tufts and large patches of grass that apparently tolerate the toxic metals and thrive under the stress of drought and mineral depletion. The successful adaptation of these rugged plants to derelict mines is a testament to the power of natural selection and provides a fine opportunity to study the process in operation.

More than one hundred years ago, Charles Darwin hinged his theory of evolution on the natural selection of individuals. Through the differential survival and reproduction of variants appearing in each generation, traits that adapt an organism to a particular habitat can increase in frequency in future generations. A century after the publication of *Origin of Species,* British geneticist Anthony Bradshaw and his students at University College of North Wales in Bangor set out to piece together a detailed picture of rapid adaptation among plants to the presence of heavy metals. To do so, they focused on the significance of natural variation.

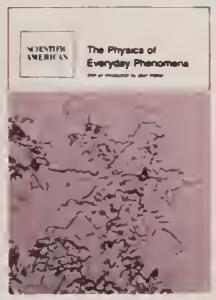
Bradshaw and his students noticed that although pastures surrounding local mines were rich with species apparently unable to survive on the contaminated mine soils, there were some species growing in both habitats. For example, *Agrostis tenuis,* a wind-pollinated grass found in abundance in the pasture, forms sparse populations on mine soils. Two explanations of this phenomenon seem possible. On the one hand, perhaps certain species, such as *Agrostis,* possess a tolerance mechanism that enables them to extend their range to the excavation site. Alternatively, most of the pasture plants of *Agrostis* may not be able to tolerate heavy metals, and the colonizers of the mine may represent exceptional individuals that have adapted to the metals.

To determine which possibility is correct, researchers have developed an assay to measure the degree of tolerance possessed by an individual plant. They grow selected tillers or seedlings of a test plant in two solutions: one, the control, supplies only the nutrients found in normal soil; the second also contains a toxic concentration of a particular heavy metal. In the second nutrient solution, nontolerant plants do not grow roots, but the roots of tolerant individuals rapidly proliferate. Hence the vigor of the root growth in the toxic medium, compared with the growth in the control medium, provides a reliable index of tolerance. On this scale a rating of zero indicates a lack of tolerance, while a completely tolerant plant is rated ten.

Bradshaw sampled plants of *Agrostis* from a local mine and the surrounding pasture and grew them in the metal solution and the control. The tolerant plants rapidly rooted to form vigorous tillers, but the roots of the pasture plants were stunted and the shoots did not grow. The mine populations were clearly different from those found in the pasture and had evolved heavy metal tolerance since the original excavations. Moreover, although some mining operations date from the Middle Ages, many *Agrostis* populations have been discovered growing on mines less than one hundred years old; this evolution must be remarkably rapid.

Because the tolerant and nontolerant populations of *Agrostis* grow so close together, the explanation for such rapid evolution is more complex than simply quick adaptation to new conditions. Tolerant individuals of *Agrostis* grow well on mine soils in the presence of heavy metals and under harsh habitat conditions. Their offspring share their tolerance, indicating a strong genetic basis for this adaptation. In the pasture, nontolerant *Agrostis* survive nicely, competing

THIS BOOK FREE WITH YOUR SUBSCRIPTION



Yes, I want to stay up-to-date in all the sciences.

Enter my subscription to the monthly issues of SCIENTIFIC AMERICAN for the term I have checked. As soon as my payment is received, you will also send me The Physics of Everyday Phenomena (regular price $5.50), as my bonus. This new anthology explores the mysteries of such ordinary events as fog, thunder, raindrops, snow crystals, river meanders, ocean waves and the salt in the sea.

MY GUARANTEE

I may cancel my subscription at any time and receive a refund on the unused balance. The bonus book is mine to keep.

SCIENTIFIC AMERICAN

WC

- ☐ 1 year – $21
- ☐ 2 years – $38 (I save $4)
- ☐ 3 years – $52 (I save $11)

- ☐ My payment is enclosed.
- ☐ Bill me.

(Rates outside U.S. and Canada: 1 year – $27 2 years – $48 3 years – $64)

NAME _____

ADDRESS _____

CITY/STATE/ZIP _____

NATURAL HISTORY

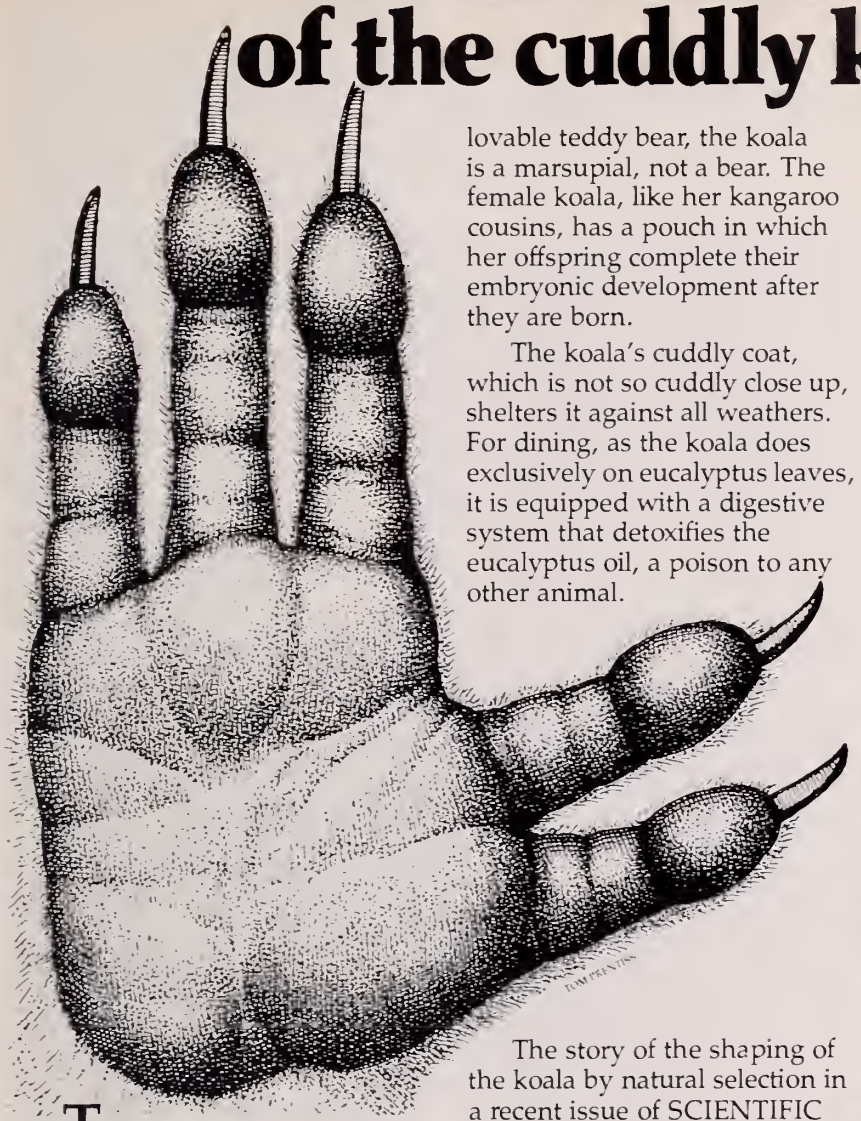
NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD
First Class Permit No. 6005 New York, N.Y.

POSTAGE WILL BE PAID BY

SCIENTIFIC
AMERICAN
P.O. Box 5918
New York, N.Y. 10164

Is this the hand of the cuddly koala?



This powerful, clawed hand does indeed belong to the koala. It testifies to the rigorous adaptation of the animal to its tree-top habitat.

Commonly fancied as a lovable teddy bear, the koala is a marsupial, not a bear. The female koala, like her kangaroo cousins, has a pouch in which her offspring complete their embryonic development after they are born.

The koala's cuddly coat, which is not so cuddly close up, shelters it against all weathers. For dining, as the koala does exclusively on eucalyptus leaves, it is equipped with a digestive system that detoxifies the eucalyptus oil, a poison to any other animal.

The story of the shaping of the koala by natural selection in a recent issue of SCIENTIFIC AMERICAN, by Australian mammalogist Robert Degabriele, gave our readers new insight as well into a grander story—the process of evolution that shaped us all.

This is the kind of direct communication between the scientist and the interested layman that SCIENTIFIC AMERICAN conducts so admirably. In our magazine scientists in all disciplines report their new work and, in collaboration with our editors, place the work in its deepest perspective.

Why not join our more than 700,000 regular readers at the frontiers of knowledge? A diversity of interest awaits you in each monthly issue.

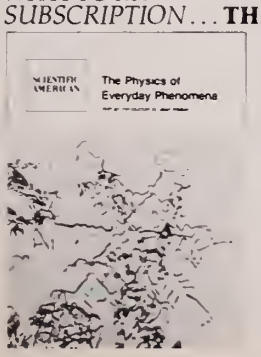
A one-year subscription is only $21. A two-year subscription at $38 saves $4. And a three-year subscription at $52 saves you $11.

Send no money. We'll bill you.



SCIENTIFIC AMERICAN

WITH YOUR SUBSCRIPTION... **THIS FREE BOOK**



As soon as your subscription payment is received, we will also send you *The Physics of Everyday Phenomena* (regular price: $5.50), as your bonus. This new anthology explores the mysteries of such ordinary things as fog, thunder, raindrops, snow crystals, river meanders, ocean waves and the salt in the sea. For example: How would you describe the shape of a falling raindrop?

SCIENTIFIC AMERICAN 415 Madison Avenue, Dept.WC, New York, N.Y. 10017

Yes, enter my subscription to the monthly issues of SCIENTIFIC AMERICAN for the term I have checked. As soon as my payment is received, you will also send me—absolutely free—the new anthology *The Physics of Everyday Phenomena* (regular price: $5.50).

MY GUARANTEE

I may cancel my subscription to SCIENTIFIC AMERICAN at any time and receive a refund for the unused balance. The bonus book is mine to keep.

NAME

ADDRESS

CITY STATE ZIP WC

☐ 1 year—$21 ☐ 2 years—$38 (save $4) ☐ 3 years—$52 (save $11)

☐ My payment is enclosed ☐ Bill me

(Subscription rates outside U.S. and Canada 1 year—$27 2 years—$48 3 years—$65)

NEW!
FOR YOUR KITCHEN
Beauty and Versatility Combined.
The Butcher Block Kitchen Work Center is a convenient counter extender or an efficient work island...and the focal point of the kitchen you'll be proud of. Outstanding quality at a very reasonable price.

• Solid Rock Maple – handcrafted in Vermont.
• Non-stick Butcher Block top 2'x3', standard counter height.
• Locking casters roll easily and stay put.
• 2'x3' lower storage shelf.
• Child-safe knife rack – many other features, too!

SPECIAL INTRODUCTORY PRICE!
Send today for FREE details!
Garden Way Research
Charlotte, VT 05445
©1981 GARDEN WAY INC
Butcher Block Kitchen Work Center
(Please Print Clearly)
Garden Way Research
Dept. A1041K
Charlotte, VT 05445
Name _____
Street _____
City _____
State _____ Zip _____


Let Them Grow With a Questar
Children with intense curiosity about the nature of things will learn to master many tools, and the telescope, that prime tool of science, should be the first. Only the finest telescope, combining mechanical and optical perfection, can become a true extension of the mind and hand. Such an instrument is the Questar, and its lovely versatility adds an extra dimension to many fields: astronomy, terrestrial studies, or perhaps simply to the pure enjoyment of wildlife. What else could you buy a child that would enchant, amuse and continue to serve for a lifetime?
Send for our booklet in color on the portable, photovisual Questar. $2, please, to cover mailing on this continent. Airmail to S.A., $3.50; Europe and N. Africa, $4; elsewhere, $4.50.
QUESTAR
8ox GY, New Hope, Pa. 18938 (215) 862-5277

vigorously with the wide array of other species in the field. The two populations meet at the boundary of the toxic soil. Since these plants are pollinated by wind, some pollen from each side fertilizes plants on the other side. As a result, some offspring on the mine side of the boundary should inherit nontolerant genes, and seed produced on the pasture side should display some tolerance.

This movement of genes in both directions could be expected to create an array of tolerances among offspring and a continuous transition zone from very tolerant plants well into the mine to very intolerant plants well into the pasture. Surprisingly, there is a very sharp break in the tolerance of the two populations, and the border between them is a clearly defined, sharp line. Although mine and pasture plants are only inches apart at the boundary, the mine individuals are fully tolerant, whereas the neighboring pasture plants fail to grow in the smallest concentrations of heavy metals. How is such a distinct boundary maintained in spite of the flow of genes back and forth between mine and pasture?

A critical tension exists between this movement of homogenizing genes between two different *Agrostis* populations and the selective factors working to maintain particular qualities of the populations. When wind-borne pollen carrying nontolerant genes crosses the border and fertilizes the gametes of tolerant females, the resultant offspring show a range of tolerances. The movement of genes from the pasture to the mine would, therefore, tend to dilute the tolerance level of seedlings. Only fully tolerant individuals survive to reproduce, however. This selective mortality, which eliminates variants, counteracts the dilution and molds a totally tolerant population. The pasture and mine populations evolve distinctive adaptations because selective factors are dominant over the homogenizing influence of foreign genes.

Thus evolution—the continuous sculpting of particular physiologies, morphologies, and behaviors—is accomplished through the differential survival of variants created in reproduction. Plants, because they do not move, lend themselves to observation of the process of evolution. The particular elegance of studying metal tolerance in *Agrostis* lies in our ability to measure variation and watch how it changes with each generation. Natural selection, which may ordinarily run long and slow, is captured in the act, held for inspection by the opposing flow of genes.

Tom McNeilly, a student of Bradshaw's, separated the effects of selection from the flow of genes by observing a population of *Agrostis tenuis* he found growing on a derelict copper mine in Caernarvonshire, Wales. The mine's surface, less than 985 feet across, sits on the floor of a U-shaped, glaciated valley whose steep slopes are covered with sheep pasture. McNeilly suspected that the east-west orientation of the valley, which strongly polarizes the prevailing winds in a westerly direction, might provide an appropriate setting for his work.

Toward the end of the summer, McNeilly collected seeds from a group of marked adult plants on the mine. He germinated thirty seeds and subjected the seedlings to the tolerance test in a nutrient solution with a toxic concentration of copper. The marked adults were then transplanted to a greenhouse where, isolated from the pasture plants, they formed a new batch of seeds exclusively through the exchange of pollen among themselves. These greenhouse seeds were also germinated and their seedlings tested for tolerance. Finally, the marked adults themselves were subjected to the copper solution. McNeilly could then compare the tolerance of adult plants with that of their greenhouse offspring; the tolerance of the same adult plants with that of their mine offspring; and, finally, the tolerance of the mine offspring with that of the greenhouse offspring.

The adult plants displayed a relatively narrow range of tolerance and had an average index between six and seven. A few individuals were as low as five, but considerably more displayed a high tolerance of seven. The seedlings that germinated from the isolated greenhouse seed also displayed an average tolerance between six and seven. As expected in offspring, however, the range of tolerance was greater: one of the seedlings was as low as three, while another, at ten, was completely tolerant. This wider variability among offspring compared with parents is the result of the recombination of genes, through sexual reproduction, into many different sets among the progeny. Because the average indexes of adults and their offspring were identical, we can conclude that the expression of tolerance is controlled by genes. Of more interest is

How good do you have to be to own a Hasselblad?



The reputation that Hasselblad enjoys as the choice of professional photographers and advanced amateurs might lead you to believe that it's a difficult camera to use. Nothing could be further from the truth. In many respects a Hasselblad is easier to use than other cameras, despite the extraordinary results it gives.

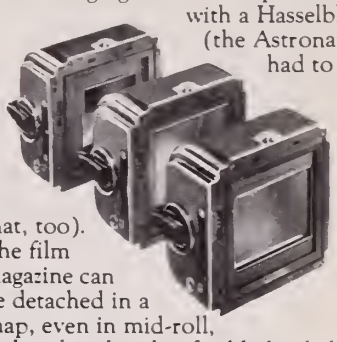
Consider the viewing system, for example. You don't have to squint with one eye through a tiny peephole. Instead your subject is projected big and bright onto the 2¼″ x 2¼″ ground glass screen. This makes it considerably easier to compose your photograph and to focus accurately. And what you see in the viewfinder is two-dimensional, just like your finished prints or slides.

A further aid to creativity is the automatic depth of field indicator on the lens that gives you a choice of settings that will put the foreground or background in or out of focus.

A Hasselblad handles beautifully. It cradles comfortably in the palm of your hand. All controls are logically placed and easy to reach (the U.S. Astronauts were able to operate their Hasselblad cameras on the moon while wearing bulky gloves).

As a matter of fact, a Hasselblad lets you do things you can't do with a 35. Such as viewing and shooting with the camera held upside down overhead (great for shooting over crowds). Or for taking pictures at ground level without having to lie down (useful for nature photographs, or for shooting at unusual angles).

Changing film is a simple matter with a Hasselblad (the Astronauts had to do that, too).



The film magazine can be detached in a snap, even in mid-roll, and replaced with a freshly loaded magazine or with a different type of film. This allows you to switch freely from black and white to color, from negative to positive film, or from daylight to tungsten. You can even switch formats. Your choices include the ideal 2¼″ square format; the 6 x 4.5 cm format, which enlarges to 8″ x 10″; or "superslides" that can be used with any 35mm projector, giving a dramatic, screen-filling image.

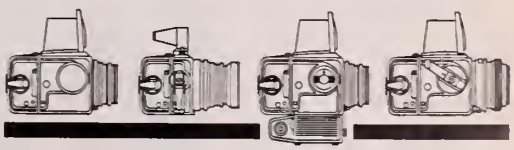
You also have access to a wide range of interchangeable lenses and accessories, because Hasselblad is the world's largest medium format system.

Creating a camera of such versatility and performance is no easy task. It takes a full year to build a Hasselblad. But then the lifespan of a Hasselblad is almost endless (ask any professional photographer). And Hasselblad's design philosophy of non-obsolescence assures that today's accessories will even fit a Hasselblad camera of twenty years ago.

So, how good do you have to be to own a Hasselblad? Just good enough to want a camera that can make you better.

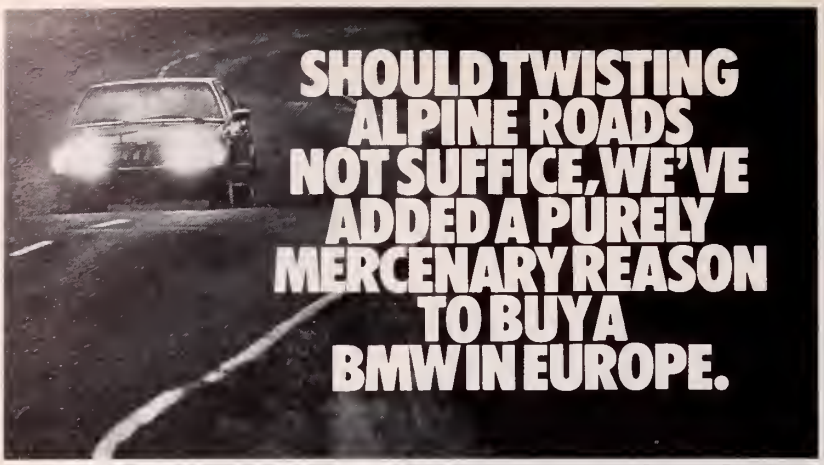
See your Hasselblad franchised dealer, or write for one of our bulletins on square composition, and a comprehensive brochure on the Hasselblad system to:

Victor Hasselblad Inc.,
Dept. A31,
10 Madison Road,
Fairfield, N.J. 07006.



HASSELBLAD®

When you shoot for perfection



While the thrill of mastering a spiny Alpine road in the BMW built for it remains as potent as ever, we recognize that these are value-conscious times.

We are therefore pleased to announce that a BMW bought in Europe is now substantially less expensive than one bought in the United States.

Further, if you imagine that the joys of European Tourist Delivery are clouded by 42-page forms, rest assured. Because your BMW dealer here at home handles everything.

BMW European Tourist Delivery Program, Montvale, New Jersey 07645

Please send me more information on your 1981 European Delivery Program.

NAME _____

ADDRESS _____

CITY _____

STATE _____

ZIP _____

THE ULTIMATE DRIVING MACHINE.

BMW MUNICH GERMANY

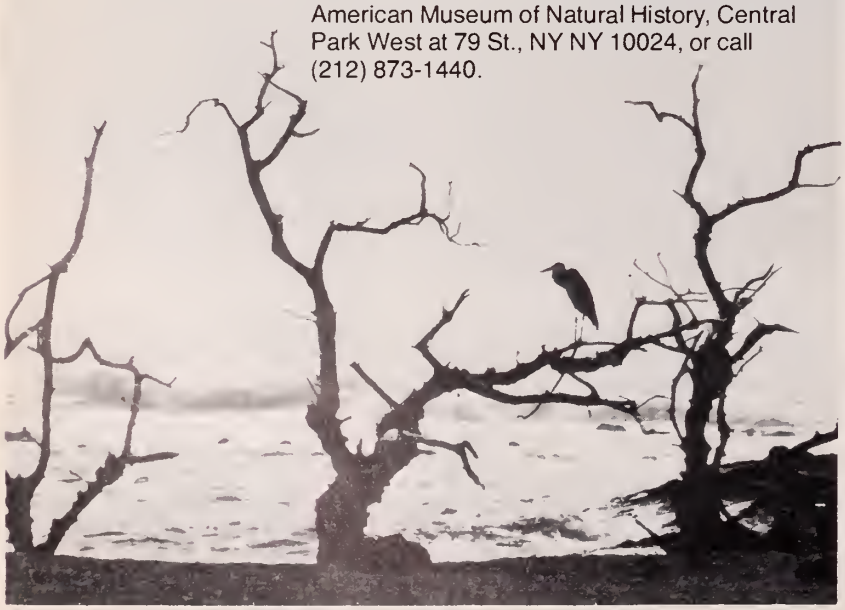
© 1981 BMW of North America, Inc. The BMW trademark and logo are registered trademarks of Bayerische Motoren Werke A.G.

American Museum of Natural History

Discovery Tours

GALAPAGOS ISLANDS CRUISE
June 13 to 25, 1981

Share the educational holiday of a lifetime with American Museum scholars and 65 compatible travelers aboard the comfortable M.V. Buccaneer. Enjoy superb climate and sandy beaches, while exploring volcanic landscapes, home to exotic and tame birds and reptiles. For further information write to DISCOVERY TOURS, American Museum of Natural History, Central Park West at 79 St., NY NY 10024, or call (212) 873-1440.



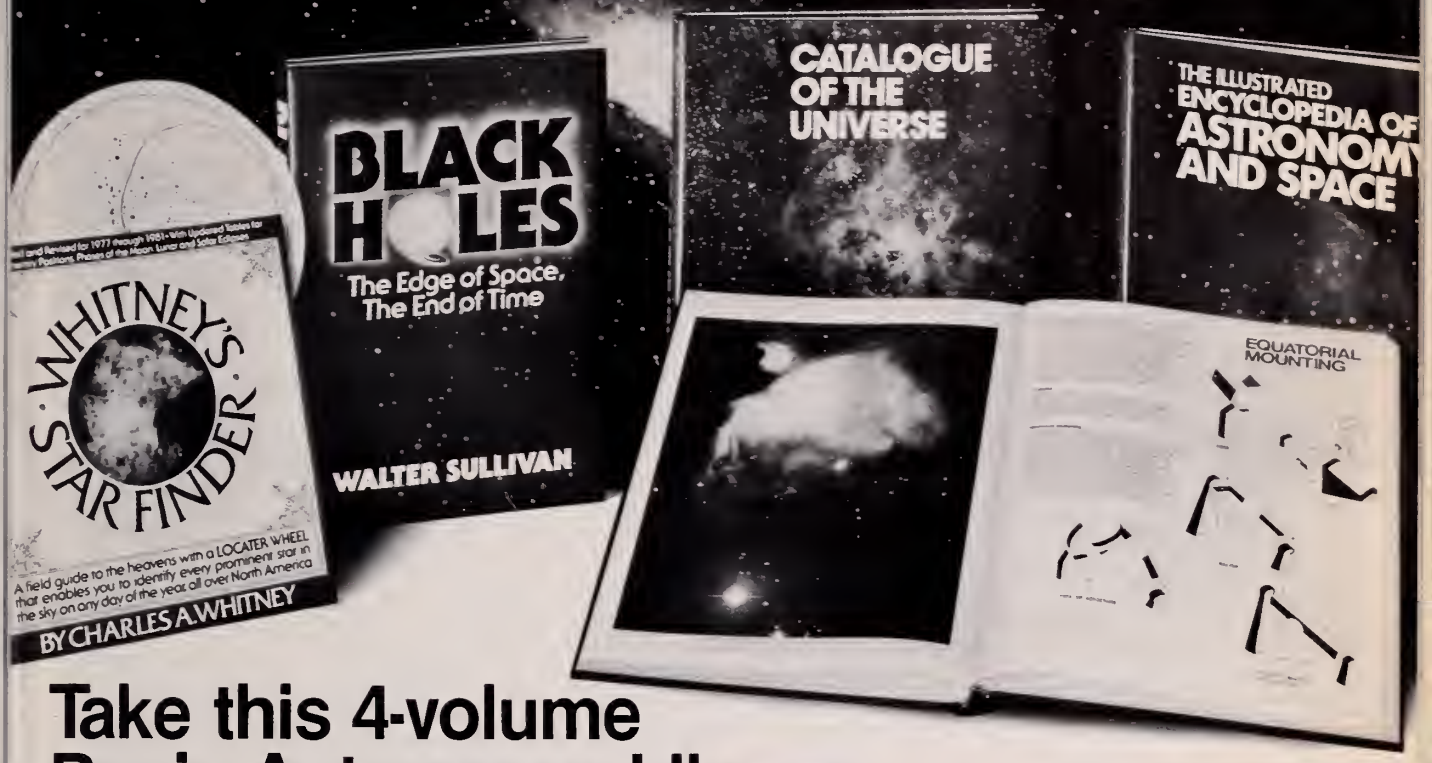
the broad range of tolerance among the progeny compared with the parents. For this new generation to display as adults the same *range* as their parents, the two extremes—low tolerance and high tolerance—would have to be eliminated. This elimination of extremes among offspring is, we believe, the measure of natural selection that maintains the tolerant adaptation among adults.

What about the tendency of gene flow from the pasture to dilute the effects of selection for tolerance? Here all is revealed by the mine offspring, germinated from seeds obtained from the adult plants still growing on the mine. The average tolerance of these seedlings is between four and five, well below that of the parents. The range of tolerance is broad, with three seedlings displaying the highest index of seven and one showing no tolerance at all. Remember, these are the individuals that under natural conditions would disperse across the mine to develop into the adults of the next generation. For the mine population to continue to have an average tolerance of six or seven, most plants with a tolerance below five would have to die. Three-quarters of this offspring population will indeed succumb to toxic concentrations of copper—a very strong selection.

The average tolerance of the mine seedlings is four or five, well below that of greenhouse seedlings at six or seven. This difference must be due to the migration of nontolerant genes: pasture pollen blows onto the mine, pollinates adults, and lowers the average tolerance of their progeny. Adult plants are capable of producing highly tolerant offspring when they interbreed in isolation, but when they grow on the mine in the presence of foreign pasture pollen, the highest tolerance of their offspring is seven. Thus, the population can never achieve total tolerance as long as mine individuals continue to cross with pasture plants. The force of natural selection is tempered by the flow of genes.

The polarity of the pollen-bearing wind in the valley where McNeilly worked permitted a field test of his findings. He marked off two transects across the boundary from the mine soils into the surrounding pasture: one was set across the prevailing wind, and the other ran downwind from the mine into the pasture. At selected locations McNeilly sampled plants and their seed, tested them for tolerance,

EXPLORE THE UNIVERSE FOR ONLY $2.95



Take this 4-volume Basic Astronomy Library for $2.95 (a $60.80 value

You simply agree to buy 3 more books—at handsome discounts—within the next 12 months.

Black holes, quasars, pulsars, supernovae, white dwarfs—explore the fantastic discoveries being made about the universe with this outstanding selection of four critically acclaimed astronomy books. Together they form a marvelously comprehensive Basic Astronomy Library.

Here is what your library will include:

WHITNEY'S STAR FINDER. *Charles A. Whitney.* Top-notch field guide to the heavens. Enables you to identify every major star in the sky over North America. Comes with a convenient Star Finder-Locater Wheel. Publisher's price $6.95

BLACK HOLES: The Edge of Space, The End of Time. *Walter Sullivan.* Bottomless pits into which whole stars can disappear . . . *Black Holes* takes you on an incredible journey that will change your picture of the universe. Hardbound. Publisher's price $17.95.

CATALOGUE OF THE UNIVERSE. *Paul Murdin et al.* Three-volumes-in-one: an atlas, encyclopedia and book of descriptive astronomy. Surveys over 220 astronomical objects. More than 300 photographs. Publisher's price $17.95.

THE ILLUSTRATED ENCYCLOPEDIA OF ASTRONOMY AND SPACE. Revised edition. *Edited by Ian Ridpath.* Your window to the universe. Over 1,000 entries and 150 photographs and illustrations. Hardbound. Publisher's price $17.95.

Discover the phenomena of space—join Astronomy Book Club today . . .

What is the Astronomy Book Club?

Astronomy Book Club is a very special club—one that is operated exclusively for astronomy enthusiasts. The Club is devoted to making the finest astronomy books available conveniently and inexpensively!

4 Good Reasons to Join

1. The Finest Books. Of the hundreds and hundreds of books submitted to us each year, only the very finest are selected and offered. Moreover, our books are always of equal quality to publishers' editions, *never* economy editions.

2. Big Savings. In addition to getting the BASIC ASTRONOMY LIBRARY for only $2.95 when you join, you keep saving substantially—up to 30% and occasionally even more. (For example, your total savings as a trial member—including this introductory offer—can easily be over 50%. That's like getting every other book free!)

3. Bonus Books. Also, you will immediately become eligible to participate in our Bonus Book Plan, with savings of at least 70% off the publisher's price on any book offered in the Club.

4. Convenient Service. At 3-4 week intervals (16 times per year) you will receive the Book Club News, describing the Main Selection and Alternate Selections, together with a dated reply card. If you want the Main Selection, do nothing and it will be sent to you automatically. If you prefer another selection, or no book at all, simply indicate your choice on the card, and return it by the date specified. You will have at least 10 days to decide. If, because of late mail delivery of the News, you should receive a book you do not want, we guarantee return postage.

Astronomy Book Club L-AH8
Riverside, New Jersey 08075

Please accept my application for trial membership and send me the BASIC ASTRONOMY LIBRARY—G(10160) for $2.95. I agree to purchase at least three additional Selections or Alternates over the next 12 months. Savings range up to 30% and occasionally even more. My membership is cancelable any time after I buy these three books. A shipping and handling charge is added to all shipments.

No-Risk Guarantee: If you are not satisfied—for any reason—you may return your introductory books within 10 days and your membership will be canceled and you will owe nothing.

Name _____

Address _____

City _____

State _____ Zip _____

(Offer good in Continental U.S. and Canada only. Prices slightly higher in Canada.)



For a Limited Time Only!

Get a Full Year of
ORION NATURE BOOK REVIEW
for only $7.99
—saving more than half the
$16.50 Single Copy Price—
and get 2 FREE BONUSES:

1. The new Orion Nature Book Service Catalog with capsule reviews of over 150 outstanding books on every aspect of nature; 8 categories make it easy to locate any title; AND
2. "Nature Day and Night" by Richard Adams, author of the bestselling "Watership Down". A full-color, 5⅛" x 9½" softbound volume published at $7.95.

Woodlands—meadows—mountain streams—even reservoirs become scenes almost of magic, as famous author Richard Adams, artist David Goddard, and scientist Max Hooper bring to you their colorful interpretations of the changes which take place as day turns to night and returns.

Subscribe today for a full year of ORION NATURE BOOK REVIEW at only 4¢ more than the regular price of the book alone! Offer good only while our present supply lasts!

SATISFACTION GUARANTEED: If you're not absolutely delighted with the first issue, we'll refund every cent. You keep the issue and the two free bonuses.

Orion Nature Book Review, P.O. Box 581, 362 Main St., Grt. Barrington, MA 01230

Yes—I don't want to miss a single issue of the ONLY publication devoted entirely to nature books. Please enter my subscription for a full year (11 issues) for only $7.99—saving me more than half under the single copy price, and send me my two FREE bonuses.

☐ Charge my ☐ VISA ☐ MastrCd Acct. No. _____ Exp. Date _____
☐ Check or money order enclosed for $_____
☐ Bill me. I understand I will get the free Catalog, but not the Richard Adams book.
☐ I prefer to double my savings and protect myself against possible price increases. Send me ORION NATURE BOOK REVIEW for 2 yrs. at only $15.98 with the bonuses.

Name _____ Sig._____
Address _____
City _____ State _____ ZIP_____

ORION NATURE BOOK REVIEW makes an excellent gift. Why not include a gift subscription for a nature-loving friend or relative? Allow 6 to 8 wks for del of first issue and bonuses. NH-1

Africa Seminars International and Christopher J. Schuberth, Geologist, and Curator of Education, The Illinois State Museum, present the **10th Annual**

EAST AFRICAN GEOLOGIC SAFARI

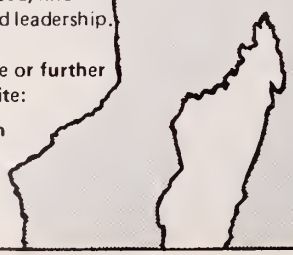


August 4—21,1981

Olduvai Gorge . . . Kilimanjaro . . . Mombasa . . . famed place names in Tanzania and Kenya.

Tanzanite . . Rift Valley . . . *Zinjanthropus* . . . are equally well known to science.

A once-in-a-lifetime 2,000-mile educational holiday adventure in a magnificent land where lion is king, the giraffe is curious about you, and their homes in the Serengeti, Ngorongoro, Amboseli, or Tsavo will become as familiar to you as they are to them. Best of all, you travel in the company of thoroughly experienced, knowledgeable, and dedicated leadership.



For a detailed brochure or further information, call or write:

Christopher J. Schuberth
Africa Seminars
1841 Broadway
New York, N.Y. 10023
Phone: (212) 765-4870

and compared the average index of parent and offspring to distinguish the effects of gene flow.

As expected, adult plants on the mine side of the first transect, running crosswind, are quite tolerant, with an index of six. The seedlings they produce have a considerably lower tolerance of about four. The difference in the tolerances of the adults and their seedlings provides a measure of the movement of nontolerant genes onto the mine soils. As McNeilly sampled closer and closer to the boundary between the mine and the pasture, the tolerance of both adults and offspring gradually dropped, to about four and three, respectively. About sixty-five feet into the pasture, *Agrostis* seedlings had a tolerance index of just over one—identical to that of the parent plants and close to that of completely nontolerant *Agrostis*.

The second transect presented a very different picture. Close to the boundary on the mine side, tolerance among adults was high, at five. The tolerance of the seedlings of these plants was only a single index point lower, possibly indicating the slight effects of pasture pollen from the upwind side of the mine. Surprisingly, this situation remained the same for more than 165 feet downwind into the pasture. Adult plants of *Agrostis tenuis* growing on pasture soil displayed a high index of tolerance and so did their progeny. Clearly there was a great infiltration of tolerant genes into the pasture population. At 230 feet from the boundary, however, the entire situation was reversed. There parent plants had a tolerance index of three while that of their seedlings was much higher, between four and five. At the last station sampled, almost 500 feet from the mine, progeny still displayed a relatively high tolerance, between three and four, although their parents, with an index of two, were nearly nontolerant. This phenomenon can only be explained by two processes: the constant migration of tolerant genes from the mine, which continues to produce higher tolerance in seedlings each generation, combined with strong selection *against* metal-tolerant seedlings in nontolerant pasture populations. Tolerant genes, which adapt plants to growth in soils with high copper content, are acquired at a cost: such individuals cannot survive in normal pasture populations.

We do not fully understand the biology behind this constraint. It may

Clearing the Nation's Air

What the chemical industry is doing to help clean up the air you breathe

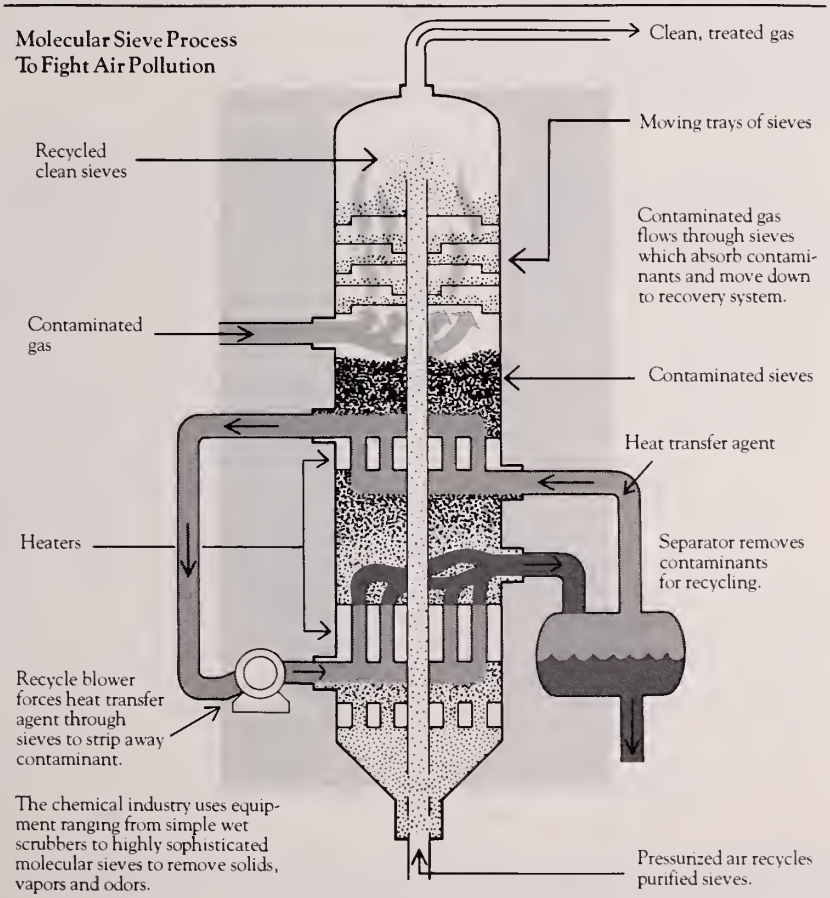
Today, almost all of our industry's plants meet or exceed Environmental Protection Agency clean air requirements. But we're not stopping there. Here are some of the ways we're helping America breathe easier:

1. Committing billions to clean up

The chemical industry is investing more than any other U.S. manufacturing industry in fighting pollution, according to the U.S. Census Bureau. Since 1976, we've doubled our investment in air pollution control equipment. By the end of 1979, this commitment exceeded $2.6 billion. We are also investing millions of dollars in environmental research. The expenditures for one research program alone are expected to exceed $9 million by the end of 1980.

2. Upgrading plants and processes

New plant construction includes sophisticated equipment and technology. Older, existing plants are being refitted with additional equipment to improve emission control and meet environmental requirements. We're also finding ways to recycle emissions to create useful raw materials.



The chemical industry uses equipment ranging from simple wet scrubbers to highly sophisticated molecular sieves to remove solids, vapors and odors.

3. Trapping particulates more effectively

A scrubber at one company helps trap more than 1,300 tons of particulate sulfur each year. Electrostatic precipitators help reduce fly ash emissions by nearly 100 percent. "Baghouses," which operate like household vacuum cleaners, also help keep dusts and solid particles from contaminating the air.

4. Capturing vapors with new technology

Research is helping us find new and better ways to control gaseous wastes. For example: a highly specialized molecular sieve recovers waste sulfur dioxide from the vent gas of sulfuric acid plants for recycling into the acid-making process. Special incinerators help control odorous gases. We've created compounds which can trap specific kinds of pollutant molecules.

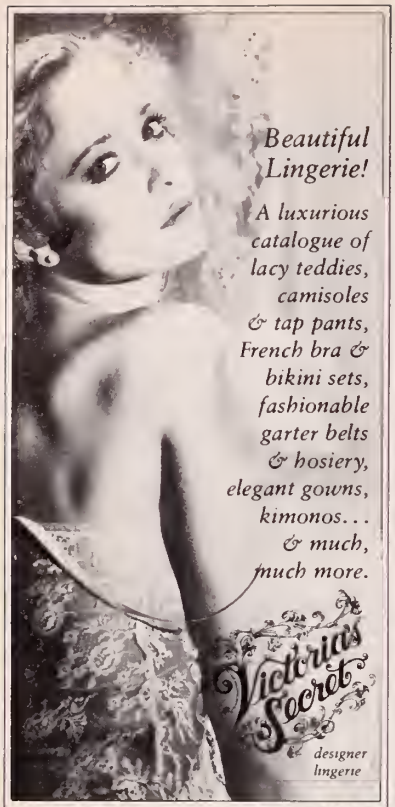
5. Getting more employees involved

We have more than 10,000 employees whose sole job is to operate, maintain and monitor pollution control equipment. And we add to this number each year. At one facility, employee programs encouraged ideas which helped eliminate 75,000 tons of air pollutants each year.

For a booklet that tells more about what we're doing to protect the environment, write: Chemical Manufacturers Association, Dept. GL-103, P.O. Box 363, Beltsville, Md. 20705.

America's Chemical Industry

The member companies of the Chemical Manufacturers Association



Send $3 for catalogue to Dept. NH-03
Box 31442, San Francisco, CA 94131
Boutiques: San Francisco, Palo Alto & Cupertino, CA



The Easy-Rolling Garden Way Cart

We guarantee OUR big, strong Carts will simplify YOUR outdoor chores. Precise axle placement and giant, easy-rolling wheels balance the heaviest...and bulkiest loads -- UP TO 400 POUNDS – without back or muscle strain. And because it carries 10 TIMES THE LOAD OF A WHEELBARROW you'll finish chores in a fraction of the time. This gives you TIME TO RELAX – TIME TO ENJOY... your home...family...friends.

Garden Way Research, Dept. A976C, Charlotte, VT 05445

YES! Please Send *FREE* 24 Page Cart Booklet
Garden Way Research
Dept. A976C, Charlotte, VT 05445
(Please Print Clearly)
Name_____
Address_____
City_____
State_____ Zip_____

involve the tolerance mechanism, which seems to enable the plant to sequester the toxic metals in an innocuous complex in the cell walls. We do know that without neighbors, tolerant plants are perfectly capable of growth on pasture soils. Competition with normal plants completely suppresses them in pastures, however, and garden experiments with mixtures of the two inevitably lead to the dominance of the pasture plants. The tolerant individuals seem unable to corner their share of light, nutrients, and water. Plants found on mines generally differ from nontolerant specimens in many ways, however, so this competitive inferiority may derive from biological characters other than the tolerance mechanism. One study of zinc-tolerant *Anthoxanthum odoratum,* sweet vernal grass, found that such individuals are smaller in stature than nontolerant plants, have smaller leaves, and are able to grow more effectively in soils with low levels of nutrients. They also flower earlier in the season and self-pollinate at a high frequency. Such reproductive characteristics tend to isolate the mine population from the flow of foreign pollen, which would otherwise lower the average tolerance among progeny. This incipient reproductive isolation of an interbreeding group of plants is the first step on the path to speciation. Perhaps the evolution of what are now two populations of *Agrostis tenuis* will in time result in the formation of two independent species.

The metal tolerance story has a pleasing epilogue in the real world of land reclamation. Bradshaw has turned his attention to the use of tolerant populations in the revegetation of contaminated soils. Derelict mines are more than an eyesore; they are also subject to severe gully and sheet erosion from surface drainage and wind. The flooding of neighboring streams and the contamination of ground water redistributes toxic spoils into surrounding pasture and agricultural land, sterilizing the vegetation and endangering grazing livestock.

In 1969 Bradshaw and his students began experiments at a number of sites. Preliminary testing of the soils revealed that phosphorus is a major nutrient limiting the establishment of plants over the whole surface. At each site they laid out a set of small half-yard plots differing in topography and applied a series of fertilizer treatments to facilitate initial growth of seedlings. They harvested seeds of tolerant populations of *Agrostis tenuis* and several other tolerant species from contaminated mines and sowed them at high densities, along with commercial, nontolerant seeds that served as controls. When growth was assessed at the end of a year, tolerant plants consistently outyielded nontolerant plants. Fertilizer applications were essential, however, and the pH of the soil determined which tolerant species were most successful: *A. tenuis,* for example, prefers strongly acidic conditions.

These experimental populations of tolerant plants proved remarkably persistent, maintaining vigorous growth for more than nine years. The conventional process of reclamation involves the surface addition of a layer of sewage sludge or topsoil, followed by the sowing of commercial varieties of grass. Bradshaw has calculated that the cost of using metal-tolerant populations with appropriate fertilizer treatments may be less than one-sixth the cost of the traditional method.

Like the best of biomedical science, Bradshaw's study of heavy metal tolerance is a paradigm of rigorous research and a prescription for increasing our well-being. But by focusing on the meaning of variation, evolutionary biology differs from medical biochemistry and physiology, where variation is often considered an unfortunate experimental error. Biomedical investigators tend to concentrate on the commonness of events, on the average pattern seen beneath the glass. Students of ecology and evolution, by contrast, are concerned with the rich pageant of diversity in nature. Far from an annoyance to be minimized by meticulous control, natural variation is recognized as essential to answering the question, Why are there so many kinds of living things?

The answer can have practical applications. Today, the National Seed Development Organization, for example, is selling cultivars of metal-tolerant *Agrostis tenuis* ready for use in reclamation. In a day when each dollar of the U.S. government's budget for pure science is subjected to intense scrutiny and each week reveals a new chemical dump in someone's backyard, we may look to Bradshaw's work for inspiration. Creative, rigorous science need not always be expensive, inexplicably abstract, or irrelevant.

Robert E. Cook is associate professor of biology at Harvard University.

FREE

Your Personal Copy of

Gallerie I

The "no imitations" catalogue of jewellery, fashions and home accessories.



No Obligation

Willoughby & Taylor Ltd.
International Merchants

Gentlemen:

Please mail me, without cost or obligation, my personal copy of Gallerie I from Willoughby & Taylor, Ltd.

NAME

ADDRESS

CITY

STATE ZIP

P07 8

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL
First Class Permit No. 12696 Chicago, IL

POSTAGE WILL BE PAID BY ADDRESSEE

Willoughby & Taylor Ltd.
International Merchants

P.O. Box 11077
Chicago, Illinois 60611



FREE.

The "no imitations" catalogue of precious jewellery, fashions and home accessories.

Send for it today.

In a world of imitations, simulations and plastic reproductions, it's rare to find a catalogue devoted solely to genuine things. In the full-colour pages of Gallerie I, you'll discover affordable precious jewellery fashioned from genuine pearls, diamonds, emeralds, rubies and other treasured stones. You'll also find beautiful fashions for women and the kinds of unique decorative accessories for the home that you seldom see in American shops. *Send for your free copy today.*

Willoughby & Taylor Ltd.
International Merchants

Free Catalogue Request

Willoughby & Taylor Ltd.
International Merchants

P.O. Box 11077 Chicago, IL 60611

Gentlemen:
I would like to have a complimentary copy of Gallerie I, the new jewellery, fashions and home accessories catalogue from Willoughby & Taylor, Ltd.

Name

Address

City

State Zip
P06 9

Kingdoms Without Wheels

Why can't living creatures—at least most of them—evolve wheellike feet?

by Stephen Jay Gould

Sisera's mother thought fondly of the booty that her son might bring back—"a prey of divers colors of needlework"—after meeting the armies of Israel led by Deborah and Barak (Judges, chapters 4–5). Yet he was overdue, and she began to worry: "Why tarry the wheels of his chariots," she inquired anxiously. And rightly did she fear, for Sisera would never return. The Canaanite armies had been routed, while Jael had just transfixed Sisera through the head with a nail (a tent post in modern translations)—ranking her second to Judith among Jewish heroines for the gory dispatch of enemies.

Generals of the biblical armies rode on chariots; their apparatus traveled on carts. But two thousand years later, by the sixth century A.D., the question posed by Sisera's mother could no longer be asked, for wheels virtually disappeared as a means of transportation from Morocco to Afghanistan. They were replaced by camels (Richard W. Bulliet, *The Camel and the Wheel*, Harvard University Press, 1975).

Bulliet cites several reasons for this counterintuitive switch. The Roman roads had begun to deteriorate and camels were not bound to them. Craftsmanship in harnesses and wagons had suffered a sharp decline. But, most important, camels (as pack animals) were apparently more efficient than carts pulled by draft animals (even by camels). In a long list of reasons for favoring camels to nonmechanized transport by wheels, Bulliet includes their longevity, endurance, power of abstinence from food and water, ability to ford rivers and traverse rough ground, and savings in manpower (a wagon requires a man for every two animals, but three to six pack camels can be tended by a single person).

We are initially surprised by Bulliet's tale because wheels have come to symbolize in our culture the sine qua non of intelligent exploitation and technological progress. Once invented, their superiority cannot be gainsaid or superseded. Indeed, our standard metaphor for deriding the repetition of such obvious truths proclaims that such a dull speaker must be trying to "reinvent the wheel." In an earlier era of triumphant social Darwinism, wheels stood as an ineluctable stage of human progress. The "inferior" cultures of Africa slid to defeat; their conquerors rolled to victory. The "advanced" cultures of Mexico and Peru might have repulsed Cortés and Pizarro if only a clever artisan had thought of turning a calendar stone into a cartwheel. The notion that carts could ever be replaced by pack animals strikes us as not only backward but almost sacrilegious.

The success of camels reemphasizes a fundamental theme of these columns: adaptation, be it biological or cultural, represents a better fit to specific, local environments, not an inevitable stage in a ladder of progress. Wheels were a formidable invention, and their uses are manifold (potters and millers did not abandon them, even when cartwrights were eclipsed). But camels may work better in some circumstances. Wheels, like wings, fins, and brains, are exquisite devices for certain purposes, not signs of intrinsic superiority.

The haughty camel may provide enough embarrassment for any modern Ezekiel, yet this column might seem to represent still another blot on the wheel's reputation (though it does not). For I wish to pose another question that seems to limit the wheel. So much of human technology arose by re-creating the good designs of organisms. If art mirrors nature and if wheels are so successful an invention, why do animals walk, fly, swim, leap, slither, and creep, but never roll (at least not on wheels)? It is bad enough that wheels, as human artifacts, are not always superior to nature's handiwork. Why has nature, so multifarious in her ways, shunned the wheel as well? Are wheels a poor or rarely efficient way to make progress after all?

In this case, however, the limit lies with animals, not with the efficiency of wheels. A vulgarization of evolution, presented in many popular accounts, casts natural selection as a perfecting principle, so accurate in its operation, so unconstrained in its action, that animals come to embody a set of engineering blueprints for optimal form. Instead of replacing the older "argument from design"—the notion that God's existence can be proved by the harmonies of nature and the clever construction of organisms—natural selection slips into God's old role as perfecting principle.

But the proof that evolution, and not the fiat of a rational agent, has built organisms lies in the imperfections that record a *history* of descent and refute creation from nothing. Ani-



The world is still wondering how o people who had not yet conceived of the wheel, manoged to plon ond build Mochu Picchu, a city so odvonced in orchitecture ond rood system.

It is not within the power of words to convey the visual excitement of Peru This is o country so voried thot it makes you wonder how mon ever leorned to dominote it. With the oceon, the Andes ond the Amozon competing for ottention, the eye is forever engoged No other combinotion of elements could exert such on hypnotic effect on the visitor.

In dromotic controst with its incomporoble ontiquities is Peru's modern copitol, stunning Limo However troveled, the tourist will not have found more impressive hotels on either side of the oceon, nor enjoyed more interesting food so grociously served

It is often soid thot Limo is like o huge museum, with such religious ond historicol relics os the Cothedrol on the Plozo de Armos where the remoins of the conquistodor, Pizarro, ore displayed in o gloss coffin. Neorby is the church of Son Froncisco, with catocombs rivoling those of Rome ond priceless ort treosures by well known mosters.

Todoy, Peru is still beyond your imoginotion, but is no longer beyond your budget See your trovel ogent or send for full-color literoture thot tells you everything you ought to see ond ought to know obout Peru



Peru PERUVIAN TOURISM PROMOTION FUND
7833 Haskell Avenue
Van Nuys, California 91406

NAME

ADDRESS

CITY STATE ZIP

MY TRAVEL AGENT IS

NH/3/81

UNSPOILED.



There are few places left on earth that are unspoiled. Sri Lanka is one of them. Once known as Ceylon, Sri Lanka has Asia's best game preserves. 200 species of animals, 425 kinds of birds and hundreds of square miles of leopard, elephant and sambur.

The wild flowers of Sri Lanka include a dazzling display of orchids. And where else could you find 600,000 acres of tea gardens on misty mountains?

There are 75 ways you can tour Sri Lanka. Ranging from 3 to 21 days. Accommodations begin at $5. Deluxe sells for $45. Never has your dollar worked harder. From shopping to sightseeing.

In our ancient cities, you can enjoy frenetic festivals that reflect the unspoiled nature of a culture which dates back 3,000 years.

Whether your visit is pleasure, business or a convention, our unspoiled country will spoil you. Just one hour from India, three hours from Katmandu, Bangkok and Singapore. Write for a color flyer and tour digest that includes special airfare.

sri Lanka
Pearl of the Indian Ocean.

Ceylon Tourist Board/Dept. NH13
609 Fifth Avenue, New York, NY 10017

Name

Address

City/State/Zip

RESEARCH MONIES AVAILABLE

The Winchester Museum, Buffalo Bill Historical Center, announces the availability of research monies through its Kinnucan Arms Chair Endowment Fund. The Kinnucan Arms Chair supports original research and development of scholarly studies relating to firearms in the areas of history, evolution, technology and aesthetics. Projects need not be restricted to Winchester-related subjects, but it is required that the Winchester arms collection be utilized as a source of information and research.



Inquiries for further information should be addressed to the Kinnucan Arms Chair, Buffalo Bill Historical Center, P.O. Box 1000, Cody, Wyoming, 82414.

mals cannot evolve many advantageous forms because inherited architectural patterns preclude them. Wheels are not flawed as modes of transport; I am sure that many animals would do far better with them. (The one creature clever enough to build them, after all, has gotten some mileage from the invention, the superiority of camels in certain circumstances notwithstanding.) But animals cannot construct wheels from the parts that nature provides.

As its basic structural principle, a true wheel must spin freely without physical fusion to the object it drives. If wheel and object are physically linked, then the wheel cannot turn freely for very long and must rotate back, lest connecting elements be ruptured by the accumulated stress. But animals must maintain physical connections between their parts. If the ends of our legs were axles and our feet were wheels, how could blood, nutrients, and nerve impulses cross the gap to nurture and direct the moving parts of our natural roller skates? The bones of our arms may be unconnected, but we need the surrounding envelopes of muscle, blood vessels, and skin—and therefore cannot rotate our arms even once around our shoulders.

We study animals to illuminate or exemplify nature's laws. The highest principle of all may be nature's equivalent of the axiom that for every hard-won and comforting regularity, we can find an exception. Sure enough—somebody out there has a wheel. In fact, at this very moment, wheels are rotating by the millions in your own gut.

Escherichia coli, the common bacillus of the human gut, is about two micrometers long (a micrometer is one-thousandth of a millimeter). Propelled by long whiplike threads called flagella (singular, flagellum), an *E. coli* can swim about ten times its own length in a second. Lest swimming seem easy for a creature virtually unaffected by gravitational forces and moving through a supporting and easily yielding fluid, I caution against extrapolating our view to a bacterium's world. The perceived viscosity of a fluid depends upon an organism's dimensions. Decrease a creature's size and water quickly turns to molasses. Howard C. Berg, the Colorado biologist who demonstrated how flagella operate, compares a bacterium moving in water to a man trying to swim through asphalt. A bac-

ANNOUNCING A MOST IMPORTANT NEW PORCELAIN PLATE COLLECTION . . .

THE GREAT CATS

BY PETER SKIRKA



AN EXCEPTIONAL SERIES OF EIGHT COLLECTOR'S PLATES BY OUTSTANDING WILDLIFE ARTIST PETER SKIRKA . . . HIS FIRST WORKS OF ART ON PORCELAIN.

EACH OF THE EIGHT PLATES BEARS A NEW AND ORIGINAL WORK CREATED BY MR. SKIRKA EXCLUSIVELY FOR THIS LIMITED EDITION.

EDITION LIMITED ONLY TO 5,000 SETS.

AVAILABLE BY SUBSCRIPTION ONLY.



"TIGER"

ILLUSTRATIONS SHOWN SMALLER THAN ACTUAL SIZE (9¼" DIAMETER)

The great cats. Some of the most magnificent animals in existence. An existence that becomes more endangered with each passing year.

But now, through the artistic brilliance of Peter Skirka, you can preserve forever in your home the beauty of eight of these stunning animals. For Peter Skirka, one of America's most outstanding and highly honored wildlife artists, has created his first works of art to be reproduced on fine porcelain—*The Great Cats*—a series of eight collector's plates portraying the beauty, strength, and mystery of eight of nature's most superb creatures. And as the *first* works on porcelain by this most exceptional artist, this collection is destined to have lasting importance.

Included in the collection will be the *Tiger, Leopard, Lion, Jaguar, Puma, Cheetah, Black Panther,* and *Snow Leopard.*

Commissioned by the American Collector's Guild, Ltd., the plates—a full 9¼" in diameter and with a border of precious 23 karat gold—will bear the hallmark of Phoenix Fine China, one of America's premier names in fine-art porcelain china. The exceptional whiteness and translucence of fine porcelain china are ideally suited to bring out the subtle colors and precise details of Peter Skirka's art.

The Great Cats porcelain plate collection will be strictly limited to an edition of only 5,000 sets, and will be available by subscription only. Further, to protect the integrity of the edition, no subscriber will be permitted to order more than two sets.

The collection will be issued to subscribers at the convenient rate of one plate every six weeks. The issue price of only $55 per plate will include specially written reference material, Certificate of Authenticity, and special display stand for each plate. Due to the time and care required for the crafting of each plate in this superb collection, please allow 6 to 8 weeks for delivery of *Tiger*, your first plate.

Note: If you provide your credit card number, we will automatically charge each plate shortly before it is shipped, unless you instruct us otherwise.

RESERVED SUBSCRIPTION

AMERICAN COLLECTOR'S GUILD LTD., 251 ESSEX STREET, MILLBURN, NEW JERSEY 07041

Please enter my subscription for **The Great Cats** porcelain collection, consisting of eight 9¼" plates bearing original works of art by Peter Skirka, to be sent to me at the rate of one plate every 6 weeks at the original issue price of $55* per plate. I enclose payment in full of $55* for the first plate—Tiger—and agree to pay for each succeeding plate as invoiced prior to its shipment. (*New Jersey residents add 5% sales tax.)

☐ Check or money order enclosed. (No cash, please.)
☐ Charge each plate, shortly before its shipment, to my credit card account number _____
☐ Am Exp ☐ Visa ☐ Mstr Card Expires _____

NAME (please print) _____

SIGNATURE _____

STREET _____ CITY _____ STATE _____ ZIP _____

NOTE: Please allow 6 to 8 weeks delivery.

NH



TRADITIONAL PLANTER'S HAT

This classic style is patterned after the traditional planter's hat. Fabric is breathable cotton duck in a hefty 18 oz. weight. Flexible 3½" brim shades your face and neck from the sun. Latigo leather encircles the crown, which can be contoured to your liking. A comfortable and good-looking hat on men or women. **Color:** Cream. **Sizes:** S(6⅞-7), M(7⅛-7¼), L(7⅜-7½), XL(7⅝-7¾). **Plantation Hat $16.95** ppd.

Order Today! Money Back Guarantee!

Enclosed is my check or money order for $_____
(Add sales tax where applicable.)

Please RUSH my #1954 Plantation Hat.

Size _____

Name _____

Address _____

City _____

State _____ Zip _____

☐ Send me your FREE color catalog of quality outdoor apparel and equipment.

Eddie Bauer®

Dept. DNH, Fifth & Union, Seattle, WA 98124

LYNCHBURG HARDWARE & GENERAL STORE

65 Main St., Lynchburg, TN 37352



JACK DANIEL TANSY JULEP CUP

Here's a most elegant way to enjoy Mr. Jack's favorite drink. He used to pluck some fresh tansy from his garden, crush a few lumps of sugar, and sweeten it with a dollop or two of his famous whiskey. You can too with this elegant polished pewter cup made exclusively for our friends. It has the famous Jack Daniel signature engraved on the side and holds a manly 12 ounces, (4½" tall). My **$24.50** price includes delivery.

Send check, money order or use American Express, Visa or Master Charge, including all numbers and signature

(Tennessee residents add 6% sales tax.)

For a catalog full of old Tennessee items and Jack Daniel's memorabilia, send $1.00 to the above address. Telephone 615-759-7184

terium cannot coast. If its flagella stop moving, a bacterium comes to an abrupt halt within about a millionth of its body length. The flagella work wonderfully well in trying circumstances.

After Berg had modified his microscope to track individual bacteria, he noted that an *E. coli* moves in two ways. It may "run," swimming steadily for a time in a straight or slightly curved path. Then it stops abruptly and jiggles about—a "twiddle" in Berg's terminology. After twiddling, it runs off again in another direction. Twiddles last a tenth of a second and occur on an average of once a second. The timing of twiddles and the directions of new runs seem to be random unless a chemical attractant exists at high concentration in one part of the medium. A bacterium will then move up-gradient toward the attractant by decreasing the probability of twiddling when a random run carries it in the right direction. When a random run moves in the wrong direction, twiddling frequency remains at its normal, higher level. The bacteria therefore drift toward an attractant by increasing the lengths of runs in favored directions.

The bacterial flagellum is built in three parts: a long helical filament, a short segment (called a hook) connecting the filament to the flagellar base, and a basal structure embedded in the cell wall. Biologists have argued about how bacteria move since Leeuwenhoek first saw them in 1676. Most models assumed that flagella are fixed rigidly to the cell wall and that they propel bacteria by waving to and fro. When such models had little success in explaining the rapid transition between runs and twiddles, some biologists suggested that flagella might tag passively along and that some other (and unknown) mechanism might move bacteria.

Berg's observations revealed something surprising, hinted at and proposed in theory before, but never adequately demonstrated: the bacterial flagellum operates as a wheel. It rotates rigidly like a propeller, driven by a rotatory "motor" in the basal portion embedded in the cell wall. Moreover, the motor is reversible. *E. coli* runs by rotating the flagella in one direction; it twiddles by abruptly stopping and rotating the flagella the other way!

Berg could observe the rotation and correlate its direction with runs and twiddles by following free-swimming bacteria in his machine, but S.H. Larsen and others, working in Julius Adler's laboratory at the University of Wisconsin, provided an even more striking demonstration. They isolated two mutant strains of *E. coli*—one that runs and never twiddles and another that twiddles incessantly. They "tethered" these mutant bacteria to glass slides, using antibodies that attach either to the hook or filament of the flagella and also, fortunately, to glass. Thus, the bacteria are affixed to the slide by their flagella. Larsen noted that the tethered bacteria rotate continually about their immobilized flagella. The running mutants turn counterclockwise (as viewed from outside the cell), while the twiddling mutants turn clockwise. The flagellar wheel has a reversible motor.

The biochemical basis of rotation has not yet been elucidated, but the morphology can be resolved. Berg proposes that the bottom end of the flagellum expands out to form a thin ring rotating freely in the cytoplasmic membrane of the cell wall. Just above it, another ring surrounds the flagellar base, but is not attached to it. This second ring is mounted rigidly on the cell wall. The lower ring (and entire flagellum) rotates freely, held in position by the surrounding upper ring and the cell wall itself.

Some exceptions in nature are dispiriting—the nasty, ugly, little facts that spoil great theories in Huxley's aphorism. Others are enlightening and serve only to reinforce a regularity by identifying both its scope and its reasons. These are the exceptions that prove (or probe) rules—and the flagellar wheel falls into this happy class.

Is it accidental that wheels only occur in nature's smallest creatures? Organic wheels require that two parts

WHEN YOU WRITE TO NATURAL HISTORY

about a subscription renewal, billing, or any kind of adjustment, please include your present address label.

Moving? Please notify 6 weeks in advance. Send your present address label along with your new address to Natural History Membership Services, Box 4300, Bergenfield, NJ 07621.

Name _____

New Address _____

_____

City _____ State _____ ZIP _____

Please Print — Attach Label

THE NIKON FE
A CAMERA TO STIR YOUR EMOTIONS

The automatic Nikon FE is the creative camera par excellence – the embodiment of Nikon sophistication.

Its precise meter system sets correct exposures with uncanny accuracy, automatically. Or, just turn a dial for complete manual control. Either way, the pictures are razor sharp...pure Nikon.

Offering combined capabilities found in no other automatic, it accepts Nikon's extraordinary lenses, accessories and a true 3.5 fps motor drive.

A modern 35mm classic, the Nikon FE is the finest compact automatic in its class. Priced to make it an irresistible value too! Why settle for anything less.

© 1980 Nikon Inc. Garden City, New York 11530



SALE! Thousands sold at $15. and over only $9.88

LET LOGTRAM LUG YOUR LOGS!

Enjoy Your Fireplace To The Fullest With *Safe, Convenient* Transport And Storage



Stop breaking your back . . . messing your floor

Bravo! Another dirty, uncomfortable job gone forever. This handy Logtram log lugger *manhandles* the heaviest hardwood pieces, *effortlessly*. Carts three to four armloads in one quick trip . . . with no sprained muscles, snagged clothing, or debris on the floor. Big, thoughtfully designed carriage rack is easy to load.

Oversized wheels practically 'walk' up stairs. Compact styling lets Logtram double as a dandy, *moveable* fireplace bin. Durable metal construction in handsome brass'n black finish. Disassembles for convenient off-season storage.

Logtram (Z477968)
SALE Only $9.88

ORDER NOW for quick delivery!

OLD VILLAGE SHOP
NO-NONSENSE
GUARANTEE

You must be delighted with your double-duty Logtram log carrier. You must agree it is a thoughtfully engineered, quality-constructed piece of equipment . . . or return it for a prompt full refund of purchase price—no questions asked! We guarantee it . . . in writing!!

Old Village Shop,
Hanover, PA 17331

SATISFACTION GUARANTEED! ORDER TODAY!

OLD VILLAGE SHOP, Dept. VZ-7288
340 Poplar St., Hanover, PA 17331

Please rush _____ Logtram Log Carrier(s) (Z477968) at the low, direct-to-you price of only $9.88 each plus $3.00 heavyweight shipping and handling on Full MONEY BACK GUARANTEE.
Enclosed is $_____ (PA residents add sales tax)
CHARGE IT:
☐ American Express ☐ VISA/BankAmericard ☐ Carte Blanche
☐ Diners Club ☐ Master Charge Interbank No _____
Acc't No _____ Exp. Date _____
PRINT NAME _____
ADDRESS _____
CITY _____ STATE _____ ZIP _____
We ship within 48 hours; delays notified promptly. Delivery guaranteed within 60 days.
© Old Village Shop 1979

Small Ad for a Big Tour of the Orient



Japan Air Lines has 35 very special tours to the Orient. Come, let us take you to the Orient of your dreams.
Here is but one example:
Classic Orient, 25 days, $4566. Visit Tokyo, Nikko, Nara, Miyanoshita, Kyoto, Taipei, Manila, Hong Kong, Macao, Bali, Singapore, Jahare, Bangkok. Includes all meals (most à la carte), fully escorted tours. Deluxe hotels.

Rates based on double occupancy and economy air fare from the West Coast and are subject to change. Additional charge for June–October peak season.

CALL TOLL FREE
800-835-2246,* Ext. 143
for free tour information, see your travel agent, or mail this coupon today.
Japan Air Lines, P.O. Box 10618
Long Island City, New York 11101

JAL HAPPY HOLIDAYS
JAPAN AIR LINES

Dear JAL: I've read your small ad and I'd like more details of the tours I've checked.
☐ Classic Orient (2001)
☐ Other Happy Holidays Tours

Name _____
Address _____
City _____ State _____ Zip _____
Travel Agent _____ NH0381
*Continental U.S. only. In Kansas: 800-362-2421

be juxtaposed without physical connection. I argued previously that this cannot be accomplished in creatures familiar to us because connection between parts is an integral property of living systems. Substances and impulses must be able to move from one segment to another. Yet, in the smallest organisms—and in them alone—substances can move between two unconnected parts by diffusing through membranes of the outer surfaces. Thus, single cells, including all of ours of course, contain organelles lying within the cytoplasm and communicating with other parts of the cell, not by physical connection, but by passage of molecules through bounding membranes. Such structures could, in principle, be designed to rotate like wheels.

The principle that restricts such communication without physical connection to the smallest organisms (or to similarly sized parts of larger organisms) embodies a theme that has circulated extensively throughout these columns: the correlation of size and shape through the changing relationship of surfaces and volumes. With surfaces (length ^{2}) increasing so much more slowly than volumes (length ^{3}) as an object grows, any process regulated by surfaces but essential to volumes must become less efficient unless the enlarging object changes its shape to produce more surface. The external boundary is surface enough for communication between the organelles of a single cell with their minuscule volumes. But the surface of a wheel as large as a human foot could not provision the wheelful of organic matter within. Large organisms must evolve channels—physical connections—to convey the nutrients and oxygen that can no longer diffuse through external surfaces.

Wheels work well, but animals are debarred from building them by structural constraints inherited as an evolutionary legacy. Adaptation does not follow the blueprints of a perfect engineer. It must work with parts available. Yet when I survey animals in all their stunning, if wheelless, variety, I can only marvel at the diversity and good design that a few basic and highly constrained organic patterns have produced. Forced to make do, we do rather well.

Stephen Jay Gould teaches biology, geology, and the history of science at Harvard University.

We couldn't sell our tours for less. So we gave you more.

For 1981, Alitalia offers 36 terrific Italian tours that still give you the best value on the market—only now they're even better than ever.

Despite inflation, our prices for 1981 reflect only minor increases. So in real terms you're actually paying less. And here's how we're giving you more.

We've revised our most popular itineraries to include more features that people said they wanted. Like an excursion to the Swiss resort town of Lugano on several tours. Or two nights in Verona on our "Splendors of Italy". A visit to the Frascati wine cellars on our "Grand Italian." And a side trip to the Villa d'Este Gardens on most of our tours.

We've added a major new 15-day tour called "Rome and the Sunny South" that we think is the best tour of southern Italy ever put together.

We've searched out hotels and restaurants that give you maximum luxury for your lire. And on an Alitalia tour—unlike many other tours—your hotels are always specified and guaranteed in advance.

Our tour groups are intentionally kept small, so you get more personal attention. And Alitalia lets you choose from escorted, semi-escorted or independent tours—so you don't waste money on features you don't really want.

What does all this cost? You can spend as little as $228 for 9 days/7 nights in Rome on one of our "Intermezzo" tours. Or you can splurge on our "Grand Italian," a completely escorted 15-day tour for $850. (These prices are per person, double occupancy, high season—April through October—and are for the finest first-class hotels. Prices are lower for the low season. Airfare is additional.)



For a copy of our beautiful new tour brochure, "Italy loves you," ask your travel agent, or write: Alitalia Tour Department, 666 Fifth Avenue, New York NY 10103.

Alitalia tours. They couldn't be any cheaper. And they couldn't be any better.

Alitalia

AT HOME IN THE SKY

The Seeds of Botany

In 1545, the establishment of Europe's first botanical garden in Padua, Italy, ended centuries of dependence on the ancients and set an example for plant research

by Thomas A. Christopher



To the tourist happily savoring its antiquities, the lovely city of Padua, twenty-two miles west of Venice, seems like an island in time—a place so venerable that it scarcely appears relevant to our modern technological society. Yet on June 29, 1545, one of the seminal events of modern science occurred in this small, northern Italian city. On that date the senate of the Venetian Republic, which then ruled Padua, voted to establish at the University of Padua the first botanical garden in Europe. The unforeseen consequence was nothing less than a revolution in the plant sciences, the awakening of botany from a thousand years of stagnation.

In the sixteenth century Padua was one of the intellectual centers of Europe, the home of a great university with a science faculty second to none. The Renaissance was in full flower, and under its influence, scholars in all fields were throwing off the constraints of medieval dogmatism and making great advances. The University of Padua was particularly noted as a center for botanical learning; in 1533 it had been the first European university to appoint a full-time professor of botany.

That there had not been a single university chair in botany previous to 1533 is an indication of the low state into which the plant sciences had fallen in medieval Europe. As a science, botany hardly existed; what interest there was in plants was purely practical. The only plants medieval scholars had bothered to study were those they believed had economic or medicinal value, and doctors almost entirely dominated the plant sciences. A medieval doctor had to have some rudimentary knowledge of plants since they were the major source of drugs, but even among doctors botanical research was unheard-of. They preferred to gain their knowledge of plants from ancient Greek and Roman texts.

Theophrastus (372?–287? B.C.) and Dioscorides (A.D. 40?–90?) were two ancient Greek botanists whose works were especially influential in medieval Europe; Dioscorides, in particular, was considered the final authority on everything related to plants. Both were fairly reliable sources of information given the limitations of their times. Theophrastus was by far the better scientist, demonstrating in his work keen powers of observation and deductive reasoning. Many of his theories were remarkably accurate and obviously based on the careful study of living plants, both native and foreign. Alexander the Great (356–323 B.C.), on his expeditions to Persia and India, took trained personnel to collect and send back many exotic plants and seeds. Theophrastus was thus able to study Asian plants as well as the flora of Greece; he supposedly maintained collections of foreign plants in his garden in Athens.

Symptomatic of the poverty of medieval plant science, Dioscorides' *De Materia Medica*, which was little more than a handbook of medicinal plants, was in general preferred to Theophrastus' more scholarly works. Worse yet, what real value *De Materia Medica* had was largely overlooked. Dioscorides, while he lacked Theophrastus' energetic spirit of inquiry, did emphasize the importance of fieldwork and the observation of living plants. Medieval scholars, however, chose to ignore this aspect of his book.

The natural result of the absence of primary research during the Middle Ages was that although some scholars were learned in ancient botanical literature, most were surprisingly ignorant about the native plants of their region. The botanical illustrations included in medieval editions of Dioscorides' *De Materia Medica* clearly reflect this lack of knowledge. Many of the plants Dioscorides described can be found growing wild throughout northern Europe, and yet almost without exception the illustrations were mechanically copied from earlier editions of the same book rather than drawn from nature. In this way, each new edition perpetuated the errors of its predecessors and perhaps added a few of its own, so that the illustrations in the editions published toward the end of the Middle Ages bear little if any resemblance to the plants they purport to represent.

Medieval scholars made almost no attempt to investigate the anatomy of plants, their mechanisms of growth and reproduction, or the ways in which they were related to one another. Even the basic concept that different geographical regions have different floras, which Theophrastus had grasped in an elementary form, was not understood. Throughout the Middle Ages, northern European doctors used Dioscorides as their standard reference for identifying medicinal plants without appreciating that many of the plants he described were indigenous to Greece or the Middle East and simply not to be found in England, France, or Germany.

Many of these conditions persisted in the early part of the sixteenth century. Even at the University of Padua, botany was considered nothing more than a branch of the medical curriculum. Although the university did boast the only professor of plant science in Europe, his official title was *lettore dei semplici*, or the professor of simples (simples is an archaic term for medicinal plants).

The professorship was established at the urging of Francesco Bonafede, a professor of medicine. Significantly, Bonafede, considered the best-quali-



Allen Rokach

Left: The Basilica of Santo Antonio seems to watch over the Botanical Garden of Padua University. This eighteenth-century view is taken from a history of the garden written by Roberto de Visiani, director from 1836 to 1878. The garden beds were laid out in a parterre, a geometrical pattern popular in the sixteenth century, when the garden was built. The Botanical Institute, visible at the north end of the garden, houses a library and herbarium. Below: Epinoia, the Greek nymph of Intelligence, shows a mandrake to Dioscorides (right) and Crateuas (left) in this sixth-century A.D. edition of Dioscorides' handbook of plants, De Materia Medica. *The Greek naturalist Dioscorides, who in the Middle Ages was considered to be the final authority on plants, actually lived in the first century A.D., nearly two centuries after the Greek illustrator Crateuas, famed as the best plant artist of the ancient world. Ancient and medieval scholars believed the mandrake, with its resemblance to the human form, had magical and medicinal powers.*



Österreichische Nationalbibliothek

fied applicant for the new position, taught a subject that could be described more accurately as pharmacology than as true botany. Yet, even if he was not a great botanist, botany owes Bonafede a tremendous debt: in addition to securing the establishment of a chair in that science, he was the first to propose the founding of a botanical garden at Padua.

Apparently an original thinker, Bonafede was not satisfied with the traditional academic curriculum. He wanted his students to learn about plants not just from the pages of Dioscorides and Theophrastus but also from the study of living plants. To acquire live material with which to illustrate his lectures and to give his students access to living specimens of the plants he described to them, Bonafede urged the authorities to establish a special garden. In this *orto medicinale*, or "medicinal garden," he planned to cultivate only plants used in the manufacture of drugs.



Österreichische Nationelbibliothek

Above: Their lack of field research and their reliance on ancient texts led medieval scholars to produce increasingly unrealistic botanical illustrations. The chamomile plant shown here, from the oldest known copy of Dioscorides' De Materia Medica *(circa A.D. 512), is drawn in considerable detail. But as illustrators continued to simply copy earlier editions of Dioscorides' work, they perpetuated, and added to, the errors of their predecessors. The renderings of chamomile shown on the following pages demonstrate the decline in accuracy in botanical art throughout the Middle Ages.*

Gardens of medicinal plants were nothing new in medieval Europe. Monasteries often maintained small herb gardens as a convenient source of drugs, and as early as 1447, Pope Nicholas V set aside part of the Vatican grounds for the growing of medicinal plants. What made Bonafede's proposed garden unique was its emphasis on study and research.

In time, Bonafede convinced the university administrators of the need for the garden, and they, in turn, sought the necessary funds from the government. On July 7, 1545, just eight days after the Venetian senate gave its approval, a suitable site, consisting of approximately five acres next to what is now the Alicorno canal, was leased from the monastery of Santa Giustina. Nearly surrounded by the canal, the land was both fertile and well watered. The abundant water supply insured adequate irrigation for the plants and permitted the eventual construction of seventeen fountains and several shallow tanks, which are still used to cultivate aquatic plants.

Francesco Bonafede and his colleagues in the medical faculty had intended the garden to be a teaching laboratory where a collection of medicinal plants would be maintained and a pharmacological museum would be built. In this museum, specimens of the plants grown in the garden were to be displayed, together with samples of the drugs extracted from them. This interesting plan would no doubt have proved an asset to the medical school, but it would not have provided much stimulus for botanical research. Fortunately for the fledgling science, however, the development of the garden was entrusted not only to a representative of the medical faculty, Piero da Noale, but also to an architect from the nearby city of Bergamo, Giovanni Moroni, and to a Venetian aristocrat, Daniele Barbaro.

Whether by good luck or good planning, this triumvirate proved to have a happy combination of talents. While da Noale could speak for the garden's original sponsors, an architect was clearly needed to draw up a plan for the project, and Moroni was an obvious candidate for the job: he was already supervising the construction of the church of Santa Giustina in Padua and had proved his ability on

David Lee

Right: This herbarium specimen from the Institute of the Botanical Garden of Padua University dates to about 1730, some years before Carolus Linnaeus published his system of nomenclature for flowering plants. Below: As the Middle Ages progressed, many botanical texts no longer specified authors and artists. This unattributed chamomile appears in Medicina Antiqua, *an early thirteenth-century anthology that drew upon many herbals, including* De Materia Medica.



Österreichische Nationelbibliothek

that project. Like many other figures of the Italian Renaissance, Moroni was a man of many talents; in addition to being an architect, he was a noted painter and so was able to provide aesthetic as well as technical expertise.

At first glance, Daniele Barbaro, neither a scientist nor a gardener by profession, might seem an unlikely candidate for the third member of the group. As patriarch of Aquileja, then the ecclesiastical capital of northeastern Italy, he held an important position in the ministry of the Catholic church, and his formal role in the triumvirate was to represent the Venetian senate. He was well qualified to assist in the establishment of a botanical garden, however, since in ad-



i
Liliasphodelus luteus

ii
Cana rigata

iii
Calamo aromatico



dition to being an able and energetic administrator, he was a respected amateur botanist with a family prominent in scientific circles in Venice. His great-uncle Ermolao Barbaro, a learned translator of ancient Roman scientific literature, and for many years professor of philosophy at the University of Padua, was one of Italy's foremost authorities on plant science. The senate and the university naturally turned to Ermolao's young relative Daniele when they needed assistance with the garden.

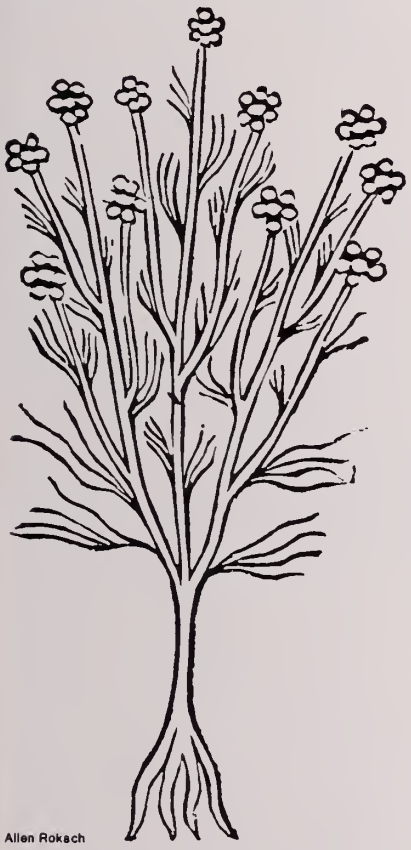
A plan of the garden was soon completed. Moroni was the draftsman, but da Noale and Barbaro, both of whom had scientific knowledge that the architect lacked, undoubtedly advised him concerning the technical aspects of the project. These three men achieved a design that was remarkable for its successful fusion of aesthetic, functional, and scientific elements. The original plan of the garden indicates that the main part was laid out as a perfect circle ninety-two yards in diameter. This circle was divided into four equal parts separated by broad paths, and each of these quadrants was subdivided into a different geometric pattern of small beds. Contemporary fashions in landscape design had influenced how the garden was laid out. Such geometric arrangements of beds, called parterres, were almost invariably prominent features in Italian gardens of this period. This design was also sensible from a practical standpoint since the large number of distinct beds made it possible to grow each variety of plant separately, facilitating the job of keeping the plant collection in order.

The original design of the garden is also interesting because it is hierarchical. Each bed is part of a larger unit, which is in turn part of a still larger unit; the progression continues up to the largest possible unit, the full circle. This suggests that the creators of the garden had some understanding of the hierarchical nature of plant taxonomy and tried to design the garden so that the plants could be arranged according to their natural relationships. Although no accurate understanding of plant taxonomy existed at that time (the present classification system is generally considered to have originated with Carolus Linnaeus in the eighteenth century), attempts had been made as early as the time of Theophrastus to classify plants according to a system of relationships. The founders of the Botanical Garden of Padua University —in particular the amateur botanist Daniele Barbaro—may have intended that the garden be planted according to some primitive taxonomic system. If so, it is the earliest example of a planting scheme that is standard in modern botanical gardens.

By August 1546, work on the garden had progressed so far that a full-time staff was necessary. Initially, the staff consisted of a director and a gardener, but a second gardener was soon added. The gardeners were responsible for the day-to-day maintenance of the garden, while the director supervised its ongoing construction, oversaw the work of the gardeners, and planned the development of the plant collections. For his services, the director received an annual salary of eighty ducats and the use of a house located on the grounds of the garden.

This modest but historic beginning marked the first time since Theophrastus' day that public funds were made available to support botanical research in Europe. Previously, botanists had been dependent for their livelihood on the generosity of wealthy patrons or had pursued their studies as an avocation while supporting themselves by working in another field. Indeed, the pioneering scientists who worked under these difficult conditions accomplished more than might have been anticipated. At Padua, however, botanists were provided not only with research facilities that were unique at the time but also with the opportunity to make botanical research their primary occupation.

The opening of the garden sparked an explosion of scientific activity. The directorship was held by a series of remarkable men who made the garden the admiration of the European scientific community. The first director, Luigi Squalermo, was one of the first Italian scientists to make journeys for the express purpose of collecting and



Allen Rokach

Above: By the end of the Middle Ages, botanical art had become highly stylized. Since medieval physicians were interested in the uses rather than the forms of plants, there was no need for the chamomile in this copy of Herbarius Latinus, *printed in the late 1400s, to be accurate. Left: Pampas grass, an ornamental grass originally from South America, was introduced into Italy in the middle of the nineteenth century at Padua. Many exotic plants were first grown in Europe at Padua's botanical garden.*

Thomas A. Christopher

First printed in 1491, Hortus Sanitatus *includes a drawing of a chamomile so schematic that it bears virtually no resemblance to the plant it is meant to represent.*



Allen Rokach

David Lee

In the fourth century B.C., the Greek naturalist Theophrastus made careful studies of living plants, including species native to Greece and exotics from Asia. Neglected for many centuries, he is now often called the father of botany.

identifying plants. In an age when travel was expensive and dangerous, he explored France, Switzerland, Italy, Yugoslavia, Greece, and Asia Minor, sending back to Padua many specimens of exotic and hitherto unknown plants. Many of his successors followed his example, notably Giovanni Veslingio, who served as director from 1638 to 1649. Veslingio explored Greece, Palestine, and Egypt and sent a collector to Crete who gathered three hundred kinds of seeds and plants indigenous to that island.

Under the direction of such men, the plant collections in the new garden grew rapidly. In 1552, just seven years after its foundation, the garden contained specimens of 1,500 different varieties of plants; by 1591, the number had risen to 2,000. Although the original intention had been to collect only medicinal plants, the collection soon expanded to encompass many plants of botanical, agricultural, and horticultural interest. Before long, Padua's collection of exotic plants became so impressive that it attracted botanists from all over Europe. Many exotic plants were grown in Europe for the first time in Padua. A number of these plants are horticulturally important today, among them the lilac (*Syringa vulgaris*), rhubarb (*Rheum rhaponticum*), and the black locust (*Robinia pseudoacacia*). And at least one plant introduced by the garden has played a vital economic role: the potato (*Solanum tuberosum*).

During its early years, the Padua botanical garden was also a leader in the field of botanical publications. While serving as its director, Squalermo wrote *Semplici*, in which he attempted to clear up the confusion that had existed throughout the Middle Ages concerning the true identity of the plants referred to by Dioscorides and other ancient authorities on medicinal plants. Squalermo tried to match each plant described by the ancient authors with a plant known to contemporary botany, and the quality of his scholarship was so high that his book was accepted as the standard reference on this subject in the sixteenth and seventeenth centuries.

Many of the earliest botanical descriptions of exotic floras were also published under the aegis of the Padua botanical garden. For example, *De Plantis Aegypti*, a study of Egyptian flora, was published by Prospero Alpino, director of the garden from 1603 until 1616. This book introduced many new plants to European botanists, and although now obsolete, it served as the basis for more complete modern studies of this subject. In 1591, the garden also became the first institution of its kind to publish a catalog and map of all the plants grown in its garden. This kind of reference work is invaluable to any scientist who wishes to study a botanical garden's plant collection, and most botanical gardens now regularly publish plant lists and maps.

The greatest achievement of the Botanical Garden of Padua University, however, was the example it set. Botanical gardens modeled on it were soon founded in other cities, first in Italy at Pisa (1547), Florence (1554), and Bologna (1568), and later outside of Italy at Leipzig (1580), Leyden (1587), and Oxford (1621). Many of these newer research institutes were larger and better endowed than the Padua botanical garden, and by the end of the eighteenth century, Padua was no longer a leader in botanical research.

Padua's botanical garden does not now hold the preeminent place it once did, but it continues to function as a center for botanical research. Now funded by the Italian government rather than by the city of Venice, the garden has preserved its affiliation with the University of Padua and still serves as a learning resource for the university's students. In addition to its collection of live plants, the garden maintains a respectable botanical library and a large herbarium of dried specimens, with a particular emphasis on the plants of the Veneto, the region surrounding Venice.

The garden is by no means a museum, but a special effort has been made to preserve its ties with the past. It still occupies the same five acres leased, and later purchased, from the monastery of Santa Giustina, and a stroll around the grounds with a copy of Giovanni Moroni's plan in hand reveals that the garden's basic design has changed little since 1545. The plant collections have grown and some modern equipment has been installed, but the collections are still planted in beds subdivided in the original geometric patterns. Many of the plant species listed in the catalog of 1591 are still being grown, although in most cases the names have changed.

Throughout the garden, magnificent old plants bear witness to the garden's antiquity. The most notable is a dwarf palm (*Chamaerops humilis*) that was planted in 1585 and was the basis for the first botanical description of this genus in 1720. There are also several enormous old shade trees, some several centuries old. In this setting, which abounds with evidence of a long, rich history, the debt botany owes to this garden and to the modest beginning made there in June of 1545 becomes strikingly clear. □



Allen Rokach

In the sixteenth century, many artists again ventured into the field to study living plants. This chamomile is from Otto Brunfels's Contrafayt Kreuterbuch. *The hand-colored illustrations in this botanical work were arranged by season, reflecting the natural order in which the artist, Hans von Weiditz, came upon the plants in the wild.*



Last Call for the Siberian Crane

A determined captive breeding effort must succeed for this stately bird to rise from the ashes of war

by George Archibald

Two magnificently sculpted cranes stand in the throne room of the emperor's summer palace in Beijing (Peking), China. The pair served the emperors as symbols of long life and happiness. Although the Chinese and other peoples have for centuries painted and sculpted cranes as harbingers of good fortune, the majestic birds could best serve the contemporary world as symbols of crisis.

The status of the Siberian crane (*Grus leucogeranus*) is particularly revealing. This endangered crane, intermediate in size between a sandhill crane and a whooping crane, has a long, powerful beak and, except for black primary feathers and a bright red face, is snow white. Within recent memory, the cranes numbered in the thousands, but as of 1979/80 the species had been reduced to approximately 250 to 300 individuals.



George Archibald; International Crane Foundation

Cranes can be bought at food stalls in Afghan towns, above. Hunting, and the outbreak of hostilities in Afghanistan, could mean the demise of the Siberian cranes that winter in India, opposite.

The attrition of this species has not been a consequence of environmental problems on its breeding grounds, which are vast expanses of sparsely inhabited tundra in Siberia. Rather, the Siberian cranes have been pressed hard by hunting and wetland destruction along their migration routes and wintering range. Now the cranes' precarious hold on existence is threatened by violent political upheavals in the Near East.

Two populations of wild Siberian cranes remain. One group breeds in western Siberia and migrates in two flocks. One flock, numbering nine birds in 1978, winters in the Caspian lowlands, which traverse the northern border of Iran. Although Iran is predominantly a country of mountains and desert, the Caspian lowlands receive precipitation adequate to sustain cultivated crops, forests, and wetlands. In recent years Iran's Department of the Environment, under the inspired leadership of Eskandar Firouz, established several wetland sanctuaries for migratory birds. Ironically, I found the relict population of cranes utilizing flooded rice fields that are part of large duck-trapping complexes.

In an attempt to restock Siberian crane populations that have been extirpated, the International Crane Foundation (ICF), Iran's Department of the Environment, and the USSR Ministry of Agriculture in 1975 began a cooperative program to place Siberian crane eggs produced in captivity into the nests of wild common cranes (*Grus grus*). The hope was that the common crane foster parents, nesting in wetlands in the western USSR, would teach their Siberian crane "offspring" the migration route to wintering areas in Iran. Since the Islamic revolution, however, the future of the foster-parenting project, the status of the relict flock of Siberian cranes, and the fate of the wetland sanctuaries is in question.

The second flock from the western Siberian crane population migrates 3,700 miles to winter at the Keoladeo Ghana Sanctuary in north-central India. These birds breed in one of the least populated areas of the world, and winter in one of the most densely populated. On the way, they stop to feed and rest at a large saline lake called Ab-i-Estada in Afghanistan, before continuing over the Hindu Kush Mountains to India. The cranes are hunted for food during their stopover in Afghanistan. As a result, this flock has declined from seventy-seven birds in 1970 to fifteen in the winter of 1980/81. In 1978 the Ministry of Agriculture of Afghanistan, in cooperation with the U.N.'s Food and Agriculture Organization and the World Wildlife Fund-International, proposed to establish Ab-i-Estada as a nature reserve and provide wardens to protect the cranes from poachers. Tragically, the recent outbreak of hostilities in Afghanistan has thwarted these conservation efforts. During a state of war, the protein packaged in a Siberian crane may spell survival for a tribesman in the backcountry.

The second, larger population of Siberian cranes, numbering about 200, breeds in eastern Siberia and winters on as yet undetermined wetlands in the basin of the Yangtze River in northeastern China. Chinese ornithologists are conducting ground sur-

Georgo Archibald; Internationel Crana Foundetion



veys to search for the wintering Siberian cranes and hope to initiate aerial surveys sometime this year. But if the wetlands used by this population are flooded by waters backed up from one of the three dams now planned along the Yangtze or if they are drained for agriculture before the birds are found, the prospects for this flock will be bleak.

On the brighter side, the ICF, located in Baraboo, Wisconsin, and the Soviet Ministry of Agriculture have established a "species bank" of captive Siberian cranes. By collecting eggs from the wild, hatching them in incubators, and hand raising the resultant chicks, ICF has established a population of twelve individuals while the Soviets maintain thirteen birds at their captive propagation center in the Oka State Nature Reserve about 200 miles southeast of Moscow.

In this era of environmental and political crises, captive breeding of Siberian cranes may offer the last hope for the survival of the species. When the smoke from the bombs clears, perhaps this great white bird will once again rise to command the skies. □

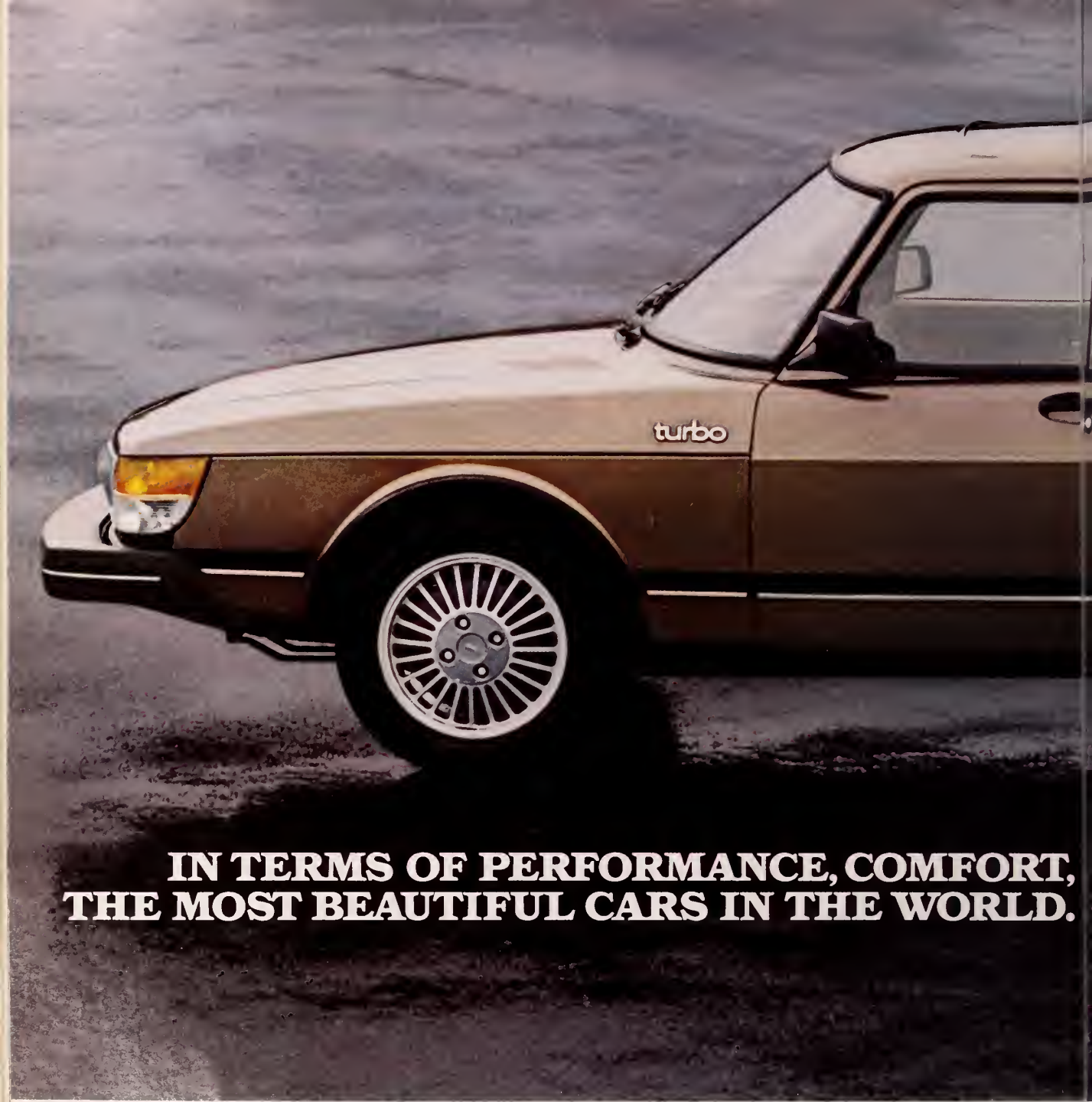
George Archibald; International Crane Foundation





George H. Harrison

Stately in flight and on the ground, Siberian cranes annually undertake long migrations from their breeding areas in the Soviet Union to their wintering grounds in China, Iran, and in the Keoladeo Ghana Sanctuary in north-central India, below.



IN TERMS OF PERFORMANCE, COMFORT, THE MOST BEAUTIFUL CARS IN THE WORLD.

How dare we call the new 1981 Saab 900 one of the most beautiful cars in the world, what with its wrap-around windshield, pointy front end, sloped rear end and just plain all-around strange looks?

Well, if you look at the Saab the way we do, you'll call it "beautiful" too.

For instance, the outside of the Saab is designed not to make your heart throb, but rather to slice through the wind.

Consequently, the Saab 900 has a low coefficient of drag, which affects performance, handling, and mileage all for the better.

At Saab, *that's* what we call "beautiful."

You may have noticed that Saabs ride a little high off the ground.

That's because we've found that adults like to sit upright in chairs, rather than sit on the floor.

So we provide the Saab with vertical seats that are up off the ground, to give you ample support for your thighs, back, shoulders, to make you as comfortable as is humanly possible. On some models, they're even heated!

And that unconventional windshield, combined with the height of the seat, gives you a phenomenal view of the road.

At Saab, *that's* what we call "beautiful."

Part of what the Saab looks like is a function of the safety features built into it.

For example, if you take away the sheet metal body, you'll see a cage of thick steel beams, pillars, cross members, floor plates, side panels, and so forth.

We call it the Saab "Safety Cage." We designed it to give you and your passengers extraordinary protection in the event of a collision.

Function, not form, was the primary objective in designing the basic shape of the Saab 900.



SAFETY, QUALITY AND ECONOMY, IT'S ONE OF

And, at Saab, *that's* what we call "beautiful."

But if you really want to see how beautiful the Saab 900 is, you have to look under the hood.

Here is the raison d'être for the Saab's very existence.

Regard the lovely, sensuous, voluptuous 2-litre fuel-injected beauty that goes like a 6- or 8-cylinder but does it with only 4.

And if that isn't enough for you, throw open the hood of the Saab 900 Turbo and gaze upon the indescribable beauty of the power plant that will accelerate you and your libido like a 747 on takeoff.

And Saabs give "beautiful" gas mileage. (Saab 900 five-speed Sedan: (21) EPA estimated mpg, 33 estimated highway mpg. Remember, use estimated mpg for comparison only. Mileage varies with speed, trip length and weather. Actual highway mileage will probably be less.)

At Saab, *that's* what we call "beautiful."

If you still need convincing that the new Saab 900 is a beautiful car, the next step is to see one up close.

Right behind the wheel of a moving one would be a good place to take a look.

Because only there can you feel the luxury, the quality, and the beauty of its power, the intelligence of its design.

See the new 1981 front-wheel drive Saab 900 at your Saab dealer today.

And maybe now you'll look at Saab a little differently.

SAAB

The most intelligent car ever built.



The Granger Collection

Genesis of the *Gossamer Condor*

A careful look at soaring birds suggested an innovative path toward human-powered flight

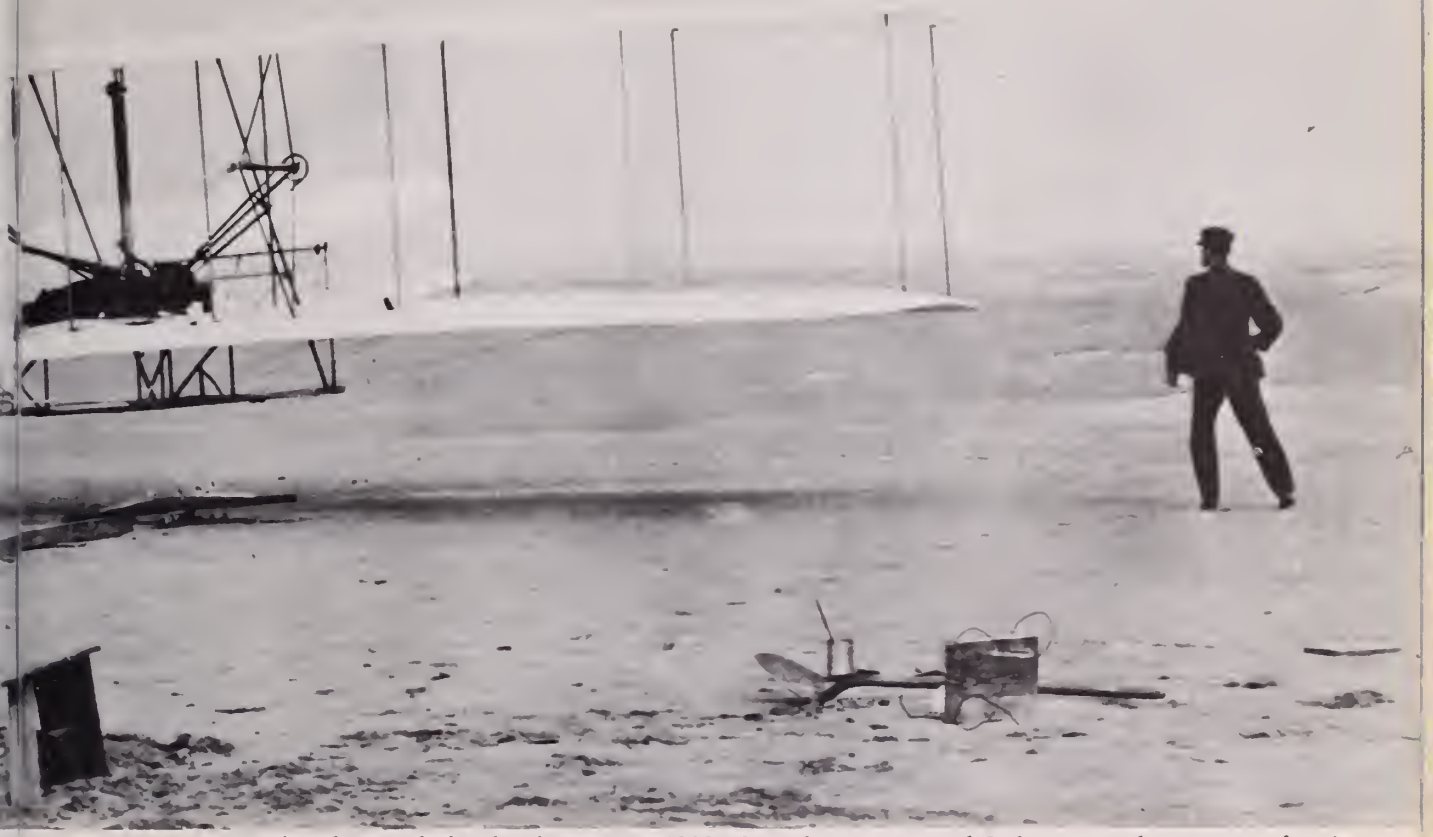
by Morton Grosser

Adapted from *Gossamer Odyssey: The Triumph of Human-powered Flight*, by Dr. Morton Grosser, to be published in April by Houghton Mifflin Company. Copyright © 1981 by Dr. Morton Grosser.

Aviation history was made in August 1977 when a fragile aircraft called the Gossamer Condor *won the £50,000 Kremer Prize for human-powered flight, successfully negotiating a figure-eight course that demanded both maneuverability and sustained flight. Less than two years later, the team that built the* Condor *captured the headlines again with the* Gossamer Albatross, *an improved human-powered airplane that flew across the English Channel. This second airplane will be exhibited at the American Museum of Natural History from March 4 to May 31.*

Tracing the beginnings of the *Gossamer Condor* is like spiraling down through a thermal, diving against the rising column of air to the small circle of warm sand where a minimal twist of wind started the whole thing. For Paul MacCready the circle of sand was probably on a beach in the town of Nokomis, Florida, in July of 1976. The MacCreadys took a family vacation that summer, driving from Pasadena to the east coast of the United States and back in a blue-and-white GMC van. Their route went through White Sands National Monument and Carlsbad, New Mexico, and across the southern part of the country. For the first time in many years Paul MacCready felt relaxed enough to forget his business problems and let his mind float.

One of the subjects that floated up repeatedly was ultralight aircraft. MacCready had just written an article on hang gliders, titled "Developments in Ultralight Gliding," and the subject was on his mind. Although his main professional activity was in meteorology, aviation was his passion. When still a boy in Connecticut, MacCready had designed and built trophy-winning



Long after the Wright brothers' success in 1903, above, human-powered flight remained an aviation frontier.

model planes and gliders. Skilled as a pilot and trained as an aeronautical engineer, in 1953 he was the first American to become international soaring (sailplane) champion.

In the spring of 1976, Doug Lamont, the editor of *Soaring* magazine, had asked MacCready to write an article on hang gliding. It was a diplomatic gesture because the directors of the Soaring Society of America were negative about this new, renegade sport. Lamont hoped that MacCready, as an outstanding member of the soaring establishment, could put hang gliding in perspective for other sailplane pilots. The article appeared just as the MacCreadys were starting their vacation; one of its most interesting parts compared the performance of hang gliders to that of gliding parachutes and soaring birds.

Soon after the trip began, MacCready became fascinated with the large soaring birds he could see through the van's windshield and would stop to scan the sky with binoculars. Anyone who has seen the curving flight of great hawks and vultures across the skies of the American Southwest can understand MacCready's interest, but his motives were not those of the ordinary bird watcher. In 1949 he had read Alfred Woodcock's classic paper on soaring sea birds, and that tour de force (in which Woodcock confirmed a laboratory discovery in fluid mechanics simply by watching birds) had made a deep and lasting impression. On this trip MacCready became convinced that he could make a similar discovery by observation. It might not be like Woodcock's inductive leap into another field of science, but perhaps he could reveal something new about the birds themselves.

Watching circling birds became first a diversion, then a compulsion, then almost the focus of the trip. By the time the family reached Florida, MacCready was stopping the van and getting out to clock the circles of turkey vultures and frigate birds. He also tried to enlist his sons as fellow observers. Parker MacCready, who was 16 that July, remembers his father's obsession vividly: "We thought he was nuts. He kept forcing us to watch birds and estimate their bank angle, and count how long it took for them to do a 360 [degree turn]."

On the west coast of Florida, MacCready had more time to observe circling birds and to sharpen the equations he had been writing in his head. He found that just by estimating a bird's angle of bank, he could—with his knowledge of flight principles—calculate the radius of the bird's circular flight path. By timing the circles, he could also calculate both the actual flight speed and the somewhat higher speed at which the bird would be flying if it flew in a straight line using the same angle of attack (the angle at which the air meets a wing traveling through it).

When equipped with an additional piece of information—the bird's "wing loading," or ratio of weight to wing area—MacCready could go on to estimate the "coefficient of lift." In aerodynamics, that is the quantity convenient for judging how efficient an object with a given shape is at flying. Unexpectedly, the average lift coefficient MacCready arrived at for soaring birds was 0.9, a considerably lower figure than had been reported earlier. When he compared this value to the lift coefficients of hang gliders, he found them surprisingly close. He de-



G. R. Zahm; Bruce Coleman, Inc.

cided that a hang glider, even though relatively inefficient when compared with a sailplane, might conceivably provide a suitable model for the construction of a human-powered aircraft.

On July 14 the MacCreadys visited Kitty Hawk, North Carolina, the site of the Wright brothers' first flights. The next day, en route to Williamsburg, Virginia, Paul MacCready found himself meditating first on bird flight, then on hang gliders, and wondering whether there was "some little hunk of aviation that hadn't been touched yet, something like a super hang glider." Although not as efficiently shaped for flying as a well-designed sailplane, birds are phenomenal flying machines because of the finely tuned control they exercise instinctively. The hang glider cannot offer any such advantage over the sailplane, but its method of construction differs radically. This was the feature MacCready thought to exploit.

A sailplane makes optimal use of rigid wings, at speeds that require a streamlined design. The framework of a hang glider, in contrast, is anything but streamlined, for it is strung with external wires that provide support through tension. Moreover, the surface of its wing, or sail, is shaped partly by the force of air, making it less efficient than a wing with a rigidly supported contour. Despite their drawbacks, however, these design elements of the hang glider permit the use of light construction materials, an advantage that becomes increasingly important the larger a structure is. And it was with a large, light structure that MacCready believed human-powered flight might be practical.

Ultimately, an airplane is supported by the upward pressure of the air on the underside of its wing. Allowing a little simplification, if two airplanes weigh the same amount and have wings of quite different sizes, the one with a much bigger wing is likely to be a "floater," and the one with a very small wing will probably be a "sinker." More precisely, an airplane falls slower if each unit of wing area has less weight to support and faster if it has more. If the sinking speed of an airplane is low, it can be kept aloft by an engine that supplies power at a relatively low rate. In addition, the lighter the airplane, the lower the power required. In an ideal situation, where all the power supplied is used to generate lift, the power necessary to fly is simply equal to the weight of the aircraft multiplied by its sinking speed.

MacCready calculated that a reasonably efficient hang glider carrying an average pilot weighs about 200 pounds and has a sinking speed of approximately 4 feet per second when flying in still air. Under these conditions, the minimum power needed to keep the glider aloft would have to be supplied at the rate of $4 \times 200 = 800$ foot-pounds per second, or 1.45 horsepower (one horsepower equals 550 foot-pounds per second, or 746 watts). MacCready reasoned that if you could triple all of a hang glider's dimensions and keep its weight about the same by using very light structural materials and external wire bracing, then the sinking speed would be decreased to one-third of its former value. That meant that such a giant hang glider would fly on only a third of the power used by a standard hang glider: 1.45/3, or 0.48 horsepower. Supplying this amount of power is within the range of human capability. (An "average fit person" can supply



Soaring birds, such as the red-tailed hawk, above, are less efficiently shaped for flying than once assumed.

up to 2 horsepower in a brief burst and can sustain about 0.25 horsepower over an indefinite period of time.)

Tyler MacCready remembers the ride to Williamsburg as "hot and buggy." His father remembers it as "pleasant," even including the interminable Beatles tapes and Monty Python skits. By the end of the day the crucial connections had come together: MacCready was sure that a human-powered airplane could be built by using hang glider technology. He didn't think the visit to Kitty Hawk had influenced him.

If every inventor in history who thought of building a human-powered airplane had actually built one, we would probably have run out of airport space long ago. In Paul MacCready's case, the motive for converting his private hypothesis into a major project was partly financial gain. The £50,000 ($86,000) Kremer Prize was being offered for the first human-powered flight around a figure-eight course that met a number of specifications concerning altitude, distance, and turning. To MacCready, the Kremer Competition was a chance to tackle a fascinating problem and possibly pay off some of his business debts at the same time. The combination was irresistible. Soon after he arrived home in Pasadena, he built what might be called a nestling: an eight-foot-span, thread-braced balsa wood and tissue model of the airplane that would become the *Gossamer Condor*.

To understand MacCready's concept, it is necessary to know how a hang glider is built. In 1976, the majority of hang gliders being flown were versions of the triangular, flexible wing glider patented by California engineer Francis M. Rogallo and his wife, Gertrude, in 1948. Because of the shape of the fabric sail, the visual impression of a Rogallo hang glider is that of a broad triangular arrowhead flying point forward. Only when the covering is removed does the fundamental shape of the frame become clear. It is really a three-dimensional cross, like a child's jack.

In a typical Rogallo hang glider, the keel tube runs fore and aft, parallel to the direction of flight. The crossbar, about sixteen feet long, runs horizontally, at right angles to the keel, and the two members are joined where they cross. Standing straight up out of this central main joint, perpendicular to both of the other frame components, is the king post, and directly below the main joint is the yoke, or control bar, which can be considered a divided downward extension of the king post. Bracing wires connect the tips of these members, and if the wires are rigged tightly, a rigid structure results. A model of the frame looks like a diamond crystal or like two pyramids joined base to base.

The two leading-edge spars that form the characteristic A-shape of a Rogallo wing are superimposed on this basic frame. Spanning about twenty-four feet, they are joined at the front of the keel and fastened to the ends of the crossbar, which serves as a transverse brace. Stripped of its skin, a Rogallo airframe looks more like a structural art project than the skeleton of a flying machine. It is unrecognizable as a relative of the elegant and highly developed sailplane.

In recent years the shapes of hang gliders have changed and diversified in a search for lower sink rates and better control. MacCready predicted this evolution in a paper he presented to the Soaring Society of America in



Frank J. Miller, Photo Researchers

1975, but the structure he visualized for his human-powered airplane was based on the x-y-z frame of the classic Rogallo hang glider.

The structure can easily be seen in the *Gossamer Condor*. The main airframe joint is still in the same central position, with the king post extending above it and a bottom post replacing the hang glider's control bar below it. The keel, as before, lies along the line of flight, but its forward end droops, becoming a bowsprit to support a stabilizing control surface. The most dramatic change is in the crossbar; from a modest brace, about 16 feet long in a standard 24-foot Rogallo, it has grown to the 96-foot main spar of the *Gossamer Condor*'s wing. Although the frame members are not truly orthogonal—the wings were eventually swept back nine degrees to adjust the center of gravity—a child's jack is still evident at the center of the *Condor*'s skeleton.

The decision to use this structure for a human-powered plane was an inspiration, but by itself a lightweight structure is not a guarantee of success. Like any object that must conform to the laws of nature, an airplane is a set of interlocking compromises, some of which have a higher priority than others.

MacCready had determined early on that a very large wing was important to reduce sinking speed. He eventually calculated that for a pilot to fly his hypothetical human-powered airplane any great distance, the sinking speed would have to be a quarter of the value for a hang glider. Allowing some realistic increased weight for the much larger structure, MacCready estimated that the projected human-powered aircraft would need nearly 1,000 square feet of wing area to provide an adequately low sinking speed.

Long, narrow wings are more efficient in most flight regimes than short, wide ones. The area and shape requirements predicted a wingspan of nearly 100 feet for MacCready's airplane. Such long wings would require an intricate web of external bracing, hundreds of feet of exposed, drag-producing wire—a prospect that would make a designer of conventional airplanes shudder. In order to fly, a plane must sustain a balance between the paired forces that act on any flying object: its lift must be equal to the pull of gravity and its thrust must be equal to its drag. There is not much thrust to spare in a human-powered aircraft.

In aerodynamics, drag is divided into two kinds: parasite drag, which is caused by the frictional resistance of air to things moving through it, and induced drag, which is the energy price the wing pays for generating lift. Since airplanes must generate lift in order to fly, designers usually try to reduce parasite drag to a minimum by streamlining and eliminating friction-producing structures. Their aim is an aerodynamically "clean" plane, which in this case seemed impossible. The only option was to fly very slowly, so that parasite drag would be low, and to depend on the big wing to provide enough lift.

MacCready probably did not realize at the time how much his own background had conditioned him to accept a wire-braced airframe. He attributed it to hang glider design, but the designers of other Kremer Prize contenders were also aware of hang gliders. Almost all of them, in different parts of the world, chose to build



The hang glider, with its wire stays and nonrigid wing, provided a model of light construction for the Condor.

streamlined, cantilever-wing monoplanes—aircraft that looked like propeller-driven sailplanes. It is a safe bet that if other designers had been offered plans for the *Gossamer Condor,* they would have rejected this primitive, wire-festooned aircraft with amusement and disdain.

No doubt, MacCready's experience building wire-braced model airplanes influenced him. He was also familiar with early full-size airplanes that had wings braced with exposed wire stays radiating from a king post. In fact—ironically—some of his open-mindedness toward the *Condor*'s structure can be attributed to his isolation from current airplane design. Since taking his Ph.D. in 1952, he had had almost no direct involvement with aeronautical structural engineering. Unlike other designers of human-powered aircraft, he was able to concentrate on the problems of flight without the need to produce a "modern" vehicle. Certainly the original sketches for the *Gossamer Condor* contained more of MacCready's past than of aviation's present.

In the beginning little more than the huge wing and bracing booms were envisioned for the plane. MacCready wanted to use as few components as possible to keep the airframe light. He hoped to stabilize the plane in pitch —fore-and-aft rotation about the wingspan axis—by placing the pilot well below the wing where his weight would act as a pendulum stabilizer, a technique still used to control some flying scale models.

Between August 10 and August 20, 1976, MacCready built a second balsa model of his design. A block of wood and some modeling clay represented the weight of a pilot at the base of the bottom post, and the wing was covered only on its upper side, again like an indoor model or a hang glider. (Later on, the design evolved to include covering on the underside of the wing as well.) The models had bowsprits carrying small stabilizers, but the first test glides showed that they were unstable in pitch.

At this point MacCready asked his friend and colleague Peter Lissaman for some advice about stabilizer size, and the nucleus of the "Gossamer Squadron" was formed. Although most of his work was concerned with large aircraft and fluid mechanics, Lissaman knew all about the Kremer Prize. When MacCready broached the giant hang glider idea, Lissaman was skeptical: "Lots of people have tried lots of technology." Still, it took him only a few moments to calculate, on the back of the proverbial envelope, that the pendulum effect of a pilot's weight would not provide enough stability in pitch; a fair-sized external stabilizer was needed.

The second model was soon fitted with a larger stabilizer and test glided successfully. "Oh, it flies backward!" the *Condor* and *Albatross* teams would become used to hearing from nonaeronautical observers reacting to the stabilizer's forward position. But this feature, known as a canard stabilizer, did not look unusual to MacCready, who had used it many times on the models he had built as a boy. It even flew. "Not a brilliant model," MacCready says, "but good enough to convince me that it was worth while to go ahead."

MacCready called his brother-in-law Kirke Leonard and announced, "I'd like to build a human-powered airplane." Leonard thus began adding his years of engineering experience



Don Monroe

and craftsmanship to the project. Within a few days the two were drawing templates and building the first wing ribs for a prototype that was to have a wingspan of eighty-eight feet—one foot less than a DC-9 Series 10 airliner. A few quick measurements showed that the plane would have to be assembled in a larger space than they had available. While aluminum tubing began to be shaped into frame members, a search for a hangar began, and MacCready recruited a fourth teammate, a soaring and hang-gliding enthusiast named Jack Lambie.

The hangar search turned up a temporary assembly site: the Rosemont Pavilion, a large building used during the construction of the mobile floral displays for Pasadena's annual Tournament of Roses. The one drawback was limited time; the building would be needed in a few weeks to begin preparations for the Rose Bowl Parade. MacCready decided to try it anyway. The materials were moved in on September 2, and for the next ten days Jack Lambie, Kirke Leonard, and Paul MacCready sawed and drilled aluminum tubing, while Peter Lissaman verified calculations.

Most of the plane's components were "lofted," or laid out, full-size on the floor, using chalk, tape, and paper templates (a method used three years later on the successor to the *Gossamer Condor*, the *Gossamer Albatross*, which flew across the English Channel). The wing spar was assembled from eight lengths of two-inch-diameter aluminum alloy tubing. There were only seven thin aluminum tubing ribs, and they were weighted with water bags to simulate flying loads while the bracing wires were rigged. The covering was Du Pont Mylar, a transparent polyester film.

Anyone who has worked in the aerospace industry can only smile at the thought of four men proposing to build an 88-foot-span airplane in ten days. It is too funny to even argue about. And yet MacCready even anticipated that the whole *Condor* project could be completed in six weeks.

In fact it took fifty-two weeks, almost to the day; but the first prototype, astonishingly, was completed on schedule. Ten days after the team started assembling the trial plane upside down on the floor of the Rosemont Pavilion, it was ready for glide tests. It even had a name. In several MacCready family conferences *Condor* had emerged as the prime candidate because of the California condor's rarity, ungainliness, and great wingspan. *Gossamer* was added because of the plane's fragility and lightness, and also, as Parker MacCready says, "Because it sounded right."

Paul MacCready was away on a business trip on September 14. When he returned at 8:30 that evening, it was to the news that the project would be losing most of its space the next morning and would have to be out of the building completely by the afternoon. He decided that they should finish the plane and fly it that night. It took three hours to cover the wing-tip rudders with Mylar, connect their rubber-band centering controls, and attach the last few wing wires.

Just after midnight Paul and Tyler MacCready, Kirke Leonard, Jack Lambie, and several friends and relations eased the huge plane out to the Rose Bowl parking lot and turned it right side up. There had been heavy ground fog all evening, and now the fog turned to a fine drizzle. The crew



Space-age materials were needed to build the Condor *and its successor, the* Gossamer Albatross, *above.*

lined up a few cars and turned their headlights on. It is tempting to imagine what a passerby might have thought of this fragile dragon with its aluminum skeleton and plastic skin shimmering in the lights: the embryo of an airplane.

The first job was to weigh the plane. MacCready had calculated its empty weight as forty-two pounds, but rainwater was already building up on the wing surface, and the first weight was fifty-eight pounds. While the team watched, the one-inch-diameter king post bowed more and more under the weight of the water, and then buckled. They hurriedly replaced it with a 1.5-inch diameter tube and rerigged the stays. MacCready decided to try glide tests in a grass parking field for the Rose Bowl, and the now-sodden group trundled the plane on a dolly across Seco Street to the field.

For the next two hours the team slogged back and forth on their makeshift runway. Crew members steadied the *Condor*'s wing tips and bowsprit while MacCready held up the bottom post and tried to control the pitch angle with a clothesline attached to the stabilizer. By 1:00 A.M. the plane weighed eighty pounds, and all the participants agreed that an hour later its original weight had doubled.

Finding agreement on what else happened that night is more difficult, an aeronautical *Rashomon*. Kirke Leonard was the most disparaging: "It was a very foggy night, and the fog turned to rain and condensed on the wings. There wasn't any head wind, but when we tried to run, it wouldn't fly at all. It never got off the ground."

Jack Lambie only saw the good parts: "Although the rain added a lot of weight, it was apparent that the craft was more like a balloon than an airplane. We walked with it at five miles per hour and it lifted easily, straining at the ropes we attached to the corners. Nothing broke in the flight tests."

For MacCready, despite the problems, the test was a confirmation of his theories. "I mainly wanted to see whether the structure would work, and if the canard stabilizer would control the pitch. It did that, maybe not perfectly, but enough so that it was worth going on. When the wing lifted, I hung on and became convinced that the design was what we had hoped for."

By 2:00 A.M. the crew had made ten test runs. In his notes on these "flights" MacCready referred to the wing as a sail; the design was still an ultralight hang glider in his mind. On their way back to the Rosemont Pavilion the team discovered one of the drawbacks of an ultralight hang glider. As they crossed Seco Street, headed northeast, a gusty tailwind hit the plane. The trailing edge of the wing bent down sharply, the right wing snapped at the inboard joint, and then at others. A few moments later several ribs buckled, the right wing tip broke off, and tears began to spread across the Mylar covering. The scene was ludicrously similar to the old films of human-powered flight attempts that are shown as real-life cartoons.

The team dragged the remains into the pavilion, disassembled them, and moved them into a storage bay. At 2:20 A.M., the prototype *Gossamer Condor* was a pile of bent aluminum tubing, wire, and bedraggled Mylar that, in fact, had never flown at all. The next morning it was trucked up to Mojave Airport, to be made into the human-powered aircraft that would win the Kremer Prize. □



Vermont Country Calendar

Town-meeting day is often the first day of mud season

by Eleanor A. Ott

Richard W. Brown



Lifelong Vermonters and newcomers from out of state attend the local town meeting.

Most of what I've learned about Vermont living I learned in Lucille Cerutti's kitchen. Lucille and I met at Goddard College, in Plainfield, Vermont, where I teach folk studies and she runs the Community Services office, helping students solve their personal problems. Lucille, like her parents, has lived in this rural Vermont area all of her life, and her special heritage colors her daily encounters with students as well as neighbors. I received my first lesson in country ways from Lucille the day I bought half a pig and she came out to my place to help me deal with the head. The result, hog's head cheese, is not unique to Vermont. It is simply part of the traditional way of living that is still found in Vermont's rural villages. In these rushed times, life in such a village is a rare experience, rich and coherent. Because of Vermont's extremes of weather, each activity, whether work or play, has its season. As Lucille has helped me to know, the passage of the months creates a satisfying cycle of country living.

Town-meeting day, the first Tuesday in March, is often also the first day of mud season. At least this is the first day that, despite high snowbanks and four feet of snow still in the woods, we really notice the mud. There is no doubt the gravel roads are beginning to thaw. So are the people, who steam up the windows in the frame meeting hall that was once the Gospel Hollow Congregational Church. The meeting begins when Sidney Liff raps his gavel, and the discussions are joined not only by Vermonters from way back, but also by newcomers like me: folks from "down country," or out of state.

The town meeting is both a political affair and a social one, a mixing of life styles and generations. Last year Eva Morse was reelected town clerk, demonstrating that women have their voice and function in town affairs. Yet it is the women who slip downstairs late in the morning session to lay the tables and set out the casseroles of food brought by townspeople for the meeting-day dinner. Each year we sit at long tables, passing around the bowls of home-baked beans and brown bread. Last year I found to my right 85-year-old Neil Converse, at his prime judged the best fiddler in the Northeast; on my left sat the new woman minister for the town's two churches.

It is no accident that town-meeting day marks the beginning of the Vermont year. This is the time when the season changes. Mercifully, winter has given people time to be idle, to knit by the fire, to make soup, to work jigsaw puzzles, to visit. But with the first days of above-freezing temperatures, as the sun melts back the snow to create ice jams and mud, the pace of life changes radically. In fact, town-meeting day comes none too soon. There are trees to tap, buckets to hang out in the woods, and then the sap must be collected and boiled into maple syrup. It's a matter of timing, of seizing chances as they come. By necessity, the work of the day must be attuned to the sun, the wind, and the weather.

As the sap rises with the first spring thaw, the task of tapping the maple trees gets under way.

Nathan Bann; Woodfin Camp

Lucille describes how sugaring was done when she was a child:

> We used to gather sap in wooden buckets. If you think aluminum buckets are heavy, you should have carried wooden ones. We tapped some 500 trees every year, and on a good day we might empty each of those buckets two or three times. Sometimes a season can last off and on for four or five weeks. And before that we had chopped and hauled the wood to burn in the evaporator to boil the water out of the sap, forty gallons of sap for each gallon of syrup. It wasn't like there wasn't anything to do.

If you don't sugar yourself, you at least stop by to visit while sap is being boiled down at a sugarhouse. Accord-

Nathan Benn; Woodfin Camp

ing to Lucille, "It's a smell you never forget—boiling sap, wood smoke, and sweaty old men." If the weather is just right and the sap is running steady, the fires and the evaporator may be tended round the clock. Visiting for a bit breaks the monotony, and you almost always get to have a taste of new syrup. "What I like to do best when they're boiling," Lucille continues, "is to take an egg, crack it lightly, and put it down in the boiling syrup in the first section of the evaporator, letting the egg ooze a little out along the shell and the taste of the syrup get into the egg. Is that good!"

Sugaring goes on, in fits and starts, during March and April, as long as the nights drop back to below freezing and the days have sun and get warm. Then the frost really comes out of the roads, the culverts collapse, and the spring rivers appear. One always runs down the middle of the road in front of Andy Scott's house, and for several weeks a wide swath of water rushes behind Forest Davis's barn. Sugaring comes to a climactic end with a sugaring-off party.

Maple sugar is made by boiling maple syrup until it reaches the right temperature and then by stirring it and beating it until it reaches the right graininess and consistency. There's never enough maple sugar, so making it is an event, almost always marked by a celebration. In the past, people piled into the sugarhouse for the sugaring-off party, but today they come more often to a farm kitchen to eat the hot syrup and maple sugar poured



Costa Manos; Magnum Photos



over bowls of fresh snow. They cut the sweetness with sour or dill pickles, set aside for this purpose when pickles were being put up in the fall, and fill up on doughnuts. The sugaring-off party used to be a big neighborhood gathering to which all the women brought homemade "plain doughnuts." "Now you might ask," grins Lucille, "what is a plain doughnut? Is it a raised doughnut or one that is made with biscuit dough? The fact is no two women's doughnuts are the same, and each of us jealously guards her own way of making them." And fifty years ago, potent sap beer was passed around more than now. This beer takes only two weeks to make from sap and hops: "It's clear like champagne. But don't be fooled," Lucille cautions. "If you drink more than a little glassful, you don't move."

During the worst of mud season a deceptive mud hole appears in front of Lucille's house on Hollister Hill. When her youngest son, Dean, was a teen-ager, he used to sit in the yard with a collection of old fence posts, planking, and big stones waiting for a car to come along. People would drive up to it, get out, stand and look. They'd even discuss the prospects with Dean. Often they would turn around and drive away, but sometimes they would say, "Oh, I can make it." Then Dean would sit and wait, and when the wheels were disappearing in the mud, he would move down the yard to help the driver drop in stones and lay the boards. Almost no car could run the hole alone, and no one accepted Dean's help without giving him a dollar or so. It was reliable mud money.

"Sugaring," Lucille explains,

is over when the peepers sing. That is the beginning of spring. Or when I go out on the porch in the morning and hear the first redwing. It's a wonderful sound. Before spring comes we want so much to taste fresh fish that we fish through the ice for anything. One day my husband, Sil, and I caught seventy-four fish through the ice, and when they were all cleaned, they weighed only two and a quarter pounds. But we ate them, they tasted so good. Some Woodbury people go smelting; there are smelt in Nelson Pond. The smelt go up the creek by Cranberry Pond. But it's time for perch fishing when the apple blossoms just begin to open. You know it's spring when you're able to open all the doors and windows and let the air in, when you look out over the countryside and see a rose-colored hue over the whole side hill.

After town meeting and sugaring, and up to Memorial Day, one of the main chores is going into the woods, where the ground is still frozen but most of the snow is gone, and cutting down next winter's wood. Later in the summer these logs will be hauled out, sawed, split, and stacked. It's getting to be more and more like the old days,

After the sap has been boiled down in a sugarhouse, left, the new maple sugar and syrup are enjoyed on bowls of fresh snow, lower left. Firewood, below, remains an important fuel, at least for auxiliary wood stoves.





Richard W. Brown

Richard W. Brown



Memorial Day is fittingly observed.

when everyone depended on wood for fuel. This is also the time when everyone is getting ready to plant.

"Before gardening really gets rolling,'" Lucille points out,

there are the repairs from winter: always some board off the porch or roof, cleaning up the mouse trash, lawns to rake after the moles, and the tilling to do. The partridges come and eat the buds off the poplars and scrub-apples on the side hill. Even as recently as when I was a child, this time between sugaring and putting in the garden was the time for getting the haying equipment ready. Then the machines were almost all pulled by horses. We would sharpen the knives on the mowing machine, grease the mower and the dump rake, and check to see that the wooden handles on the hay forks were in good condition. Since the horses had been busy all winter hauling wood, their harnesses usually needed repair.

As early as possible, Lucille's husband, Sil, works the soil in a little, protected garden and plants a little of everything that won't be killed by frost: beets, carrots, dill, lettuce, parsley, Swiss chard, peas. The main garden he plants later, on Memorial Day weekend. Sil works as a granite-stone cutter, and since he is on a night shift, he is able to work in the garden each day. "You got to have peas by the Fourth of July," insists Lucille, "so you got to plant them as soon as you can." On Memorial Day Lucille and her mother take flower wreaths to the cemetery. Some years, if it warms up quickly, Memorial Day is the beginning of black-fly season. "Sometimes the black flies get so bad, Grandma even gets to smoking cigarettes."

Sil buys seeds, onion sets, and seed potatoes in bulk from Clark's Feed Store, where he used to work. He buys enough for the whole family, for four gardens besides his own. Not more than ten miles away live Lucille's parents—Grandma and Gramps—and Lucille and Sil's three married children—Judy, Inda, and Moe—with their families. (The younger son, Dean, lives in Idaho.) Everyone takes what they need from the common seed supply. Moe and Dean used to be the ones who would help their grandparents, shovel snow off their porch roof, help dig up the garden. Now Judy's boy, the oldest great-grandson, takes care of those tasks.

Both Lucille and Sil were raised in northern Vermont. Lucille Wheeler grew up in North Montpelier and Plainfield. Her ancestors came to Vermont in the 1700s, moving north to the wilderness from Connecticut. Silvio Cerutti's father was a stonecutter from Italy who settled in Barre and worked in the stone sheds. Sil was born on a hill farm and grew up with a strong sense of his Italian heritage, eventually taking up his father's trade. Lucille and Sil have raised their children in both the New England and the Italian traditions, and all their family celebrations reflect a marriage of the two cultures.

One of the main family gatherings takes place during spring, at Easter. The whole family always goes to Lucille's parents, "to Grandma's," for Easter breakfast. The family gathering includes a few old people in town who have nowhere else to go. There's ham and eggs, and Lucille and her daughters have made hot cross buns. Everyone brings colored eggs and hides them. Each of the children takes a small straw basket, from a collection stored from year to year, and goes to gather up the eggs. All of this occurs early on Easter morning, since some in the family go on to church.

"The center of the family," explains Lucille,

was my mother and her home. As children we were always there for any holiday or special occasion. After Sil and I were married we were there, we went back there as home. Then as my children got older and my parents got older, gradually it was that my children and my parents came to my home. Now my children come with their own children. It's that way for almost every occasion except Easter breakfast and Christmas breakfast. Those are special times, and we always go to Grandma's.

The first robin, the first dandelion greens, the first radishes: every year the order of these beginnings is observed, and each bird, wildflower, and garden plant accounted for. In one patch of woods past Walter Smith's barn, beyond his sugarhouse, all the wildflowers appear in rapid succession. The tiny, insidious black fly takes its place as well. They say that when some down country speculators were nosing around to buy the side of Spruce Mountain for development, local folk showed them into the woods to survey during black flies, and they never returned. The flies can cause fever, itching, and pain. Lucille tells of the time, back when men's pants had buttons rather than zippers, that Sil went fishing during black flies and was bitten so badly, she had to sit him in baths of baking soda. It is during black-fly season that gardens go in and weeds begin to grow. And it is invariably during this time that dandelions are picked for dandelion wine. By the Fourth of July the flies are gone and the peas have come.

"You have peas and johnnycake with salt pork," relates Lucille.

You fry the salt pork until it's transparent, put in the first little new potatoes, peas, and top cream. You can do the same thing with little new string beans. And johnnycake, that's made with cornmeal. You think about it all winter when you're going to the garden and digging up parsnips and horseradish.

Plainfield, with its population of 952, plus the college community, celebrates the Fourth of July in a big way, with a parade, a chicken barbecue, and fireworks. With games, concession booths, a horse show, and an auction, the activities go on all day. "Even though the relatives from down country Long Island always



Nathan Benn, Woodfin Camp

Draft horses display their strength during summer festivities.

come," says Lucille, "it's more of a civic, or town, event than a family thing. People come back you haven't seen for a while; the town's always chock-full of people."

Actually, the planning for the Fourth of July celebration begins in January or February. A committee of local people orders fireworks, toys and games for grab bags, and several hundred chickens, and arranges for the auctioneer, the booths, and the horse show. As the day approaches, Walter Smith rubs down his ruddy Devon oxen team and the children from Maple Hill Community School make costumes. For the Bicentennial they portrayed characters from the *Wizard of Oz*. (That year the parade made the cover of *Life* magazine. Bread and Puppet Theater figures of fantastic, white-winged birds, twelve feet wide, floated under the telephone wires, and Uncle Sam danced down the hill on ten-foot-high stilts.) The parade also features Norman Dix and his rubbish-removal truck, the college's 1942 fire engine, a two-fronted car, and all the horses and bicycles in town. Even though Lucille and her daughter Judy spend most of the day in the kitchen of the village firehouse stirring vats of *mostaccioli* sauce, they never miss the parade, the Shriner calliope, the clowns. After dusk the ballfield fills with kids and cars and mating fireflies, and fireworks exploding at the edge of the bordering woods end the day.

There are never enough hours in the days of summer. Vegetables continually need picking. Lucille still puts up green and yellow beans in Mason and Ball jars. In the days before every family had a big freezer in the cellar, not only were all the different vegetables canned but chicken and beef as well. At the end of the summer it was not unusual to have 400 jars on the shelves that lined the cellar, each food in its special place. "You canned in a great big copper boiler," explains Lucille, showing its size with her arms. "You could fit fifteen quarts in the boiler if you mixed square and round jars, but only fourteen if they were all round."

The canning was not such a tedious job—many hands really did make lighter work. They still do, of course, but freezing is a lot easier than canning. The Rural Electrification Administration brought electricity into most of Vermont's rural areas in the 1930s, and freezers arrived about twenty years ago through the Washington County Electric Co-op.

Beginning with the first new moon in July, if the weather's been right, if there was enough snow cover all winter and June was not too dry, the boletus mushrooms grow. Sometimes these mushrooms are as big around as dinner plates, all shades of leathery brown on a firm stem. Their growing places are guarded secrets. Mushrooming is a passion, particularly of the Italians, as well as some of the French Canadians. For the thirty-odd years Lucille and Sil have been married, they have gone mushrooming. The whole family goes, carrying large burlap bags up the side hills.

"You lift up a spruce bough," Lucille chuckles,

and the ground is covered with mushrooms. You fall to your knees, spruce needles scratching down your neck, and pick as fast as you can. You get so excited, no matter how many times you've done



Richard W. Brown

it. You cut them off with a knife, cleaning as you go, filling the bags to bursting. Boletus comes in a growing moon in July, August, and September, up until the first hard frost. Some years there are more than you can deal with. You pick them really until you're almost sick of them. Some years they don't grow at all; those are really bad years.

Mushrooms are either frozen or dried. In the cellar at Lucille's house there is a gas range and, above it, a frame suspended from the ceiling that holds tiers of large screens. Lucille's parents, children, and grandchildren all work together at tables spread with mushrooms, first slicing them and then laying them out on the screens to be hung above the stove. All night long the mushrooms need tending. As those on the bottom screens dry, they are taken off, the top screens are lowered, and new mushrooms are put on the empty screens. Lucille and Sil often sleep in a bed in the cellar while this enterprise is going on. Ten pounds of wet mushrooms make one pound of dry. Some years, after all family members have taken off all the dry mushrooms they want, there will be seventy-five pounds left over to send down to the cousin in New Jersey who sells them in his delicatessen.

The family is together more in the summer. Twenty-two people sit down to Sunday dinner at Lucille's; the tables are laid end to end and chairs are brought from every room in the house. Everyone helps out, but Lucille organizes the dinner. There is more to the task than just minding the food.

In a complex four-generation family, the food is often the least of anyone's worries. There are differences in ages and in-laws, and a raft of children under foot. "There's not much that happens in the family that can be kept private," Lucille says emphatically,

and some people find that tough to live with. We don't; it's second nature. Almost every day, if I don't see her, I talk to

Left: A garden provides fresh food for the family table and for canning or freezing. Below: Early and late summer are times for haying. Before baling became popular, the hay was stacked with a pitchfork.



Nathan Benn, Woodfin Camp

Grandma on the phone. My daughters call me, we check in, we want to know what's going on. If I'm not talking to my older son, I'm on the phone with his wife. Every week or so I call my younger son, who is working out in Idaho, so he'll know what's happening here and we'll know what's happening to him.

When Lucille was a child, her father was a shepherd for a large merino sheep farm. This was before the Depression, while Vermont wool was still able to compete with the large sheep ranches out West. Lucille gestures toward the mountain with the fire tower visible from her kitchen window:

We used to take three thousand sheep in the summertime; we'd drive the sheep through town, drive them to Spruce Mountain and stay all summer. It was all great big open meadows up there. Going, we'd be on the road to Pigeon Pond. It took days to get there. We were kids, and time was forever anyway. It didn't matter to us, we were going for our summer fun. All these things we're doing, we always did together. Dosy, my sister who now lives in Arizona in the winter, is four years older than I am. And Donny, who was killed out West working lumbering when he was only twenty, Donny was just eleven months older than I am. So Donny and I were more together then, 'cause Dosy was always the good one. We were very near Pigeon Pond, that had a beautiful sandy beach. That's where we went swimming; oh it was just a great old time. You know, our relatives used to come up from Massachusetts and spend some time up there. We had a trailer where Ma did the cooking, otherwise we had these tents that we lived in. Got to know a lot of what went on in the world when I was up there.

In those days, forty-five years ago, most of Vermont was open land, only 10 percent tree covered. Now the situation is reversed, and young trees cover the hills and fields. Today cows have replaced sheep, and farming is precarious, with the versatile hill farm still depending on its variety and flexibility to survive the vicissitudes of weather and inflation.

Both in June and in later summer, it was time for gathering in the hay. Lucille recalls that

putting hay up in bales is a comparatively recent thing. We used to put hay into the barn by the forkful, and it packed down ever so tight; the hay didn't breathe then the way bales do now. Come along the end of June, early July, depending on the weather, they would cut the hay and gather it into windrows with the dump





Nathan Bann; Woodfin Camp

rake. The hay had to dry before it went into the barn. We had a horrible fear of fire. The hay was left to get brittle dry in the field before we ever brought it in. If it was wet, it would mildew and ferment. You could smell it. Gases form and it would blow up. The haymows in the barns were divided into sections, so if you smelled the mildew in any one section, you could use that up first.

We would walk down the windrows folding the hay over, making folded piles that could be picked up with the fork and piled up on the hay wagon and later transferred into the barn. Not everyone could pick up these hay piles and load a wagon so no hay spilled between the field and the barn. Marion Martin, who was nearly blind, could make a really good wagonload of hay, doing it by the feel of it. Then each forkload was unloaded one by one and passed up into the barn. They used to have a whole string of people like a chain up in the barn passing the forkload along. Already when I was a child they got big hay tongs, like huge ice tongs, that hung from a trolley way up in the barn. This saved time and a lot of work.

Everyone helped to hay. The old people cooked food in the kitchen, the children lugged water to people in the fields. That hay dust gets in everywhere, in your eyes, down your throat. Good haying weather is hot and the dust sticks and stings everywhere.

Even today you look over next door in the morning and see Tommy's got a lot of hay down and the sky looks threatening, big heavy clouds. All the neighbors come, you get as many wagons as you can. Everybody just goes at it. Before you know it, that hay is in the barn. We all pitched in together on a lot of jobs that were hard, tedious work, making them fun. Like husking corn. Before the corn went into the corn crib to dry, it had to be husked. All the neighbors would come to the barn on a Sunday afternoon, and we would husk and drink and sing. If you got a red ear you could go gather a kiss from the girl or boy of your choice. Sil sings a little song about all this:

The hay's all cut,
the fodder's in the shock,
and the barn's all ready
for the winter stock.

And the thrifty farmer,
says, says he,
time to be a-planning
for a husking bee.

But is there anything that can substitute for standing in the midst of a blackberry or raspberry field, the hot August afternoon ripening the berries almost quicker than you can pick





F. B. Grunzweig

Earlier in this century, most of Vermont was open land. Today, with farming economically precarious, young trees cover the hills and fields, left. A good deer season provides a winter's supply of venison, above.

and eat them, the air rich with their aroma. Or the lush smell of the blackberry pies cooling on the windowsill before supper. Or the taste as you crush a raspberry soaked in new cream against the roof of your mouth.

Every summer it's a question of what to do with more zucchini than anybody wants. The thin little zucchini appear in salads almost before they're big enough to pick. Gradually they turn into tomato and cheese casseroles, are fried with onions, wind up in bread, become pickles, get set in a crock with yeast to become wine. In a good year you can't even give them away. They lie on the vine getting ever larger. When neighbors meet, after taking care of the weather, they complain about zucchini and discuss ways to disguise them.

The first frost of fall always comes before all the tomatoes have ripened. Then a flurry of anxious activity before sunset wraps ghosts of sheets around the tall tomato plants, turning the garden into a silent phantom choir. After the dangerous days at the time of full moon pass, several more weeks of warm weather will turn many tomatoes red, the last crop of parsley and Swiss chard will be cut, all the potatoes brought in.

"Fall is the very best time of the year to make red flannel hash," says Lucille.

You have all those good things right out there in the garden. You put your meat to boiling, corned beef or a ham. You go out to get your beets, carrots, turnips, cabbage, and potatoes and head for the house just as fast as you can. You want to have a lot more beets than you'd dream you ever wanted, to make the hash good and red. First you put the beets in with the meat, the beets are going to take the longest. That's how you guide it. The carrots and turnips get added next. The cabbage and potatoes go in at the end. You cook it until it's just done. You're making a whole lot more of this than you need for dinner. You eat this first with salt, pepper, butter, and vinegar. What's left you grind up in the meat grinder, that makes the hash. Some of this gets put in the freezer so you can pull out a little hash made with all those fresh vegetables all winter long.

You keep pushing right through the summer and fall, right up to deer season. It doesn't ever let up. Everybody's got more jobs to do than hours in the day. Sil always has a real big garden, the whole family is over here so much. You got to take care of it, get it in. Then the old hens come around.

It's not worth carrying most year-old hens over the winter, they can't go outside to forage, feed is expensive, they don't lay. Lucille doesn't keep chickens, but plenty of people do. There's no shortage of old hens for people willing to pick them up live and do them in. Forty old hens on a Sunday morning brings out the whole family. At one end of the line out behind the house, by the big cellar door, Lucille's father is wielding the ax. Sil dunks the dead birds in hot water and hangs them from a beam in the cellar. Many hands pluck out the feathers. Lucille, her mother, and Inda gut and quarter the still-warm birds (Judy hates this job). In front of Lucille is a crockery bowl filling up with yellow unlaid eggs. The packaged hens go into the cellar refrigerator to cool for a day, then into the freezer. All winter long these old hens will be centerpieces for Sunday dinners of risotto and all the fixings. Lucille feels the family learns about their Italian heritage from the Sunday dinners.

Other birds are eaten besides hens. Inda is as good a shot as her brothers at deer, but it's mostly the men who duck hunt from blinds in the bays



of Lake Champlain and who bring in the partridges. Occasionally, other birds—including bluejays, pigeons, crows—are taken illegally. The breasts are baked slowly in a sauce to make *uccellini*, an Italian dish served with polenta. *Uccellini* was prepared more frequently by the preceding generation of Italians—the ones who also ran liquor down over the Canadian border during Prohibition, made wine, and distilled *grappa* (brandy) to sell in their kitchens. But neither the occasional private still nor the clandestine pigeon pie has vanished.

The appearance on porches of stuffed figures with pumpkin heads at Halloween marks the close of the growing year. The side hills have burst into a riot of cinnamon and yellow, brilliant reds, oranges, golds. For a few brief weeks at the end of September and beginning of October, the air, the very wind, is colored by the leaves' display. This is the time for gathering, peeling, and drying apples, for vats of applesauce bubbling on the stove, for apple jelly and apple pie, for Walter Smith's cider, and for don't-drink-it-if-you're-sitting-'cause-you-won't-get-up hard cider.

Already, while the leaves were still in color, there was a little snow. Now as November approaches—and deer season—the wind is sharp, and by Thanksgiving and the end of deer hunting, the ground will have gone white for the next five months. School's been under way again for all the grandchildren for some weeks now, with the stepped-up activity it always requires. The days were far more intense for Lucille and Sil when their children were young.

You got more into it when all the kids were home. Everybody was taking part in whatever we were doing. When we were kids, we almost never went out of the village, the way kids do today. I don't remember going to the city, Montpelier or Barre, ten miles away. We didn't have to go, you just never went. Our fun was wherever we were, we made our own, and we had a great time. If we went to North Montpelier, what we thought were the grown-up people used to come out and play hide-and-seek with us at night. And it was hide-and-seek all over town.

Deer season brings that intensity back again: everyone comes to Lucille's and stays, her children and their families. It's deer camp right at home, with breakfast before dawn and looking all morning for the first deer to be brought in. Then there's deer liver for breakfast the next morning. Each deer is hung out behind the house and in the evening the family takes to the cellar to cut up and package the meat. It's a time for tall tales and for the remembered tales of other deer seasons. For two weeks this goes on, all the adults having saved vacation time for it, kids staying home from school. There are always people having coffee in the kitchen, and Lucille's parents come over for polenta and venison, for mushrooms and deer stew. Some years the family gets enough deer so that everyone gets a good winter's supply. Some years are lean. But whatever deer are taken are shared, starting with Lucille's parents, who no longer get their own.

Lucille tells how one of her sons was so excited the first time he saw a deer that he emptied his whole barrel, six shots, right into a tree, and didn't even know he'd missed.

And once there was an albino deer turned up in the field at the far end of the pond. For a long time nobody shot it, it kept appearing, all white looking, and then you didn't see it any more. But an animal like that could never make it for long. It's a marked thing.

Just as deer season is ending, Thanksgiving comes—a big, festive family time. Everyone is there for the dinner, which includes antipasto, turkey, venison, squash, pickles, cranberries, and gorgonzola and cheddar cheeses. And there is butternut pie, lemon pie, apple pie, and pumpkin pie, all made from scratch. "There are so many of us now," Lucille grins,

that at Thanksgiving we draw names for Christmas. The kids draw kids' names, the old folks do it too. It's a great old time. We've been together a lot, we've been through a lot together, it keeps you together and it keeps you going. Our problem sometimes is we do not know how to make the very best of all the riches we have, it's all so simple.

Winter sets in. Pages get turned down in the well-thumbed catalogs, and orders go off to Sears and L.L. Bean. The whole family goes to Grandma's early Christmas morning for sausages and pancakes and waffles with hot maple syrup, and for the exchange of presents determined by the Thanksgiving drawing. And there is almost always new snow. Years ago the season included sleigh rides and skating on the pond. In those days they cut ice from the pond all winter:

It must be that when they cut the ice, the water would come up over the top and flood it, because 'most all winter it would be just like one huge big skating rink from start to finish. Oh it was fun. People used to come from miles around. All Sunday would be like a big party. We'd have big bonfires right out on the ice and cook hot dogs. We had an old Model T Ford out there that we used to run up and down the pond with, play snap the whip with, we really had an awful good time.

One winter when Lucille was a small child, her father got inflammatory rheumatism and nearly died. "So near that we kids were conditioned for it." She remembers that

he laid in the bed, they had to feed him. They'll never know what old Doc Corson did to pull him through. Finally, when he started getting better so he could feed himself, it got to be Christmas time. Of course, without Dad working for so long, there was no money. So I remember Ma telling us that as we hadn't been able to help with this Christmas, Santa Claus wouldn't be able to bring us anything.

At this time they were having a community Christmas tree down at the town clerk's office. We used to go on the night before Christmas, and there'd be a huge Christmas tree, with a present on it for everybody there, along with the usual candy box full of candy and stuff. Everybody in the town went, there were refreshments, we'd sing Christmas carols. I remember Seth took us down 'cause Ma had to stay home with Dad. Seth was from around here, his whole family was, he was just a little old wizened-up friend, a gentle old guy that whatever he did he had patience with it. He taught you how to do whatever he was doing, explained what he was doing and why, and you didn't soon forget it. Well, Seth took us down to the community Christmas tree, and then brought us home and we all went to bed. But Seth had been a busy person while this was all going on with Dad being sick. When we got up the next morning there was a Christmas tree in the living room with a present for each one us kids under it. And I can see mine to this day—a sled, a sled!

Pretty quickly it gets to be New Year's. People do different things on New Year's Eve, but for many years Lucille and Sil have played pinochle with friends. "That is when you begin to enjoy the winter." Lucille folds her arms and smiles. "It's feeding wood into the stove in the cellar and playing Scrabble at the kitchen table, making a pot of beans, and when the blizzards come, pulling shut the curtains and having some quiet and peace." □

Richard W. Brown

Deadwood Decomposers

On their way to becoming piles of humus, fallen Douglas fir trees support an insect community numbering more than 300 species

by Mark Deyrup

In every forest ecosystem there is an insect community that is instrumental in the death and rapid decomposition of trees. A year after its death, an insect-infested tree in the proper environment has been profoundly changed. The inner bark has been reduced to a conglomeration of insect frass; the outer bark has loosened and is profusely perforated, allowing extensive leaching by rainwater; the sapwood contains numerous insect galleries from which fungal hyphae spread, extracting and concentrating nutrients from the xylem. In succeeding years, as the tree proceeds on its way to becoming an elongate pile of humus, it is host to innumerable insects, which are sustained by the energy and minerals hoarded by the living tree for years before its death.

This community of insects does more than mediate decomposition in dead trees, for some species attack and kill weakened trees in the manner of carnivores removing infirm ungulates from the herd. Insects usually give the *coup de grâce* to suppressed, diseased, or injured trees and branches and to trees in unsuitable sites. Removal of these permanently stressed trees usually promotes the growth and stability of forest stands by reducing competition and recycling nutrients. Insects that attack weakened trees may also attack trees temporarily stressed by drought or defoliation. Removal of these basically healthy trees can drastically alter a forest stand and does not normally contribute to the health or stability of the stand. Overstocked even-aged stands are composed largely of stressed trees that may be readily attacked by insects. If only the weakest trees are attacked, the stand is gradually thinned, freeing the stronger trees from competition. If the entire stand is attacked, it is likely to be replaced by another overstocked even-aged stand that in turn may be devastated by insects.

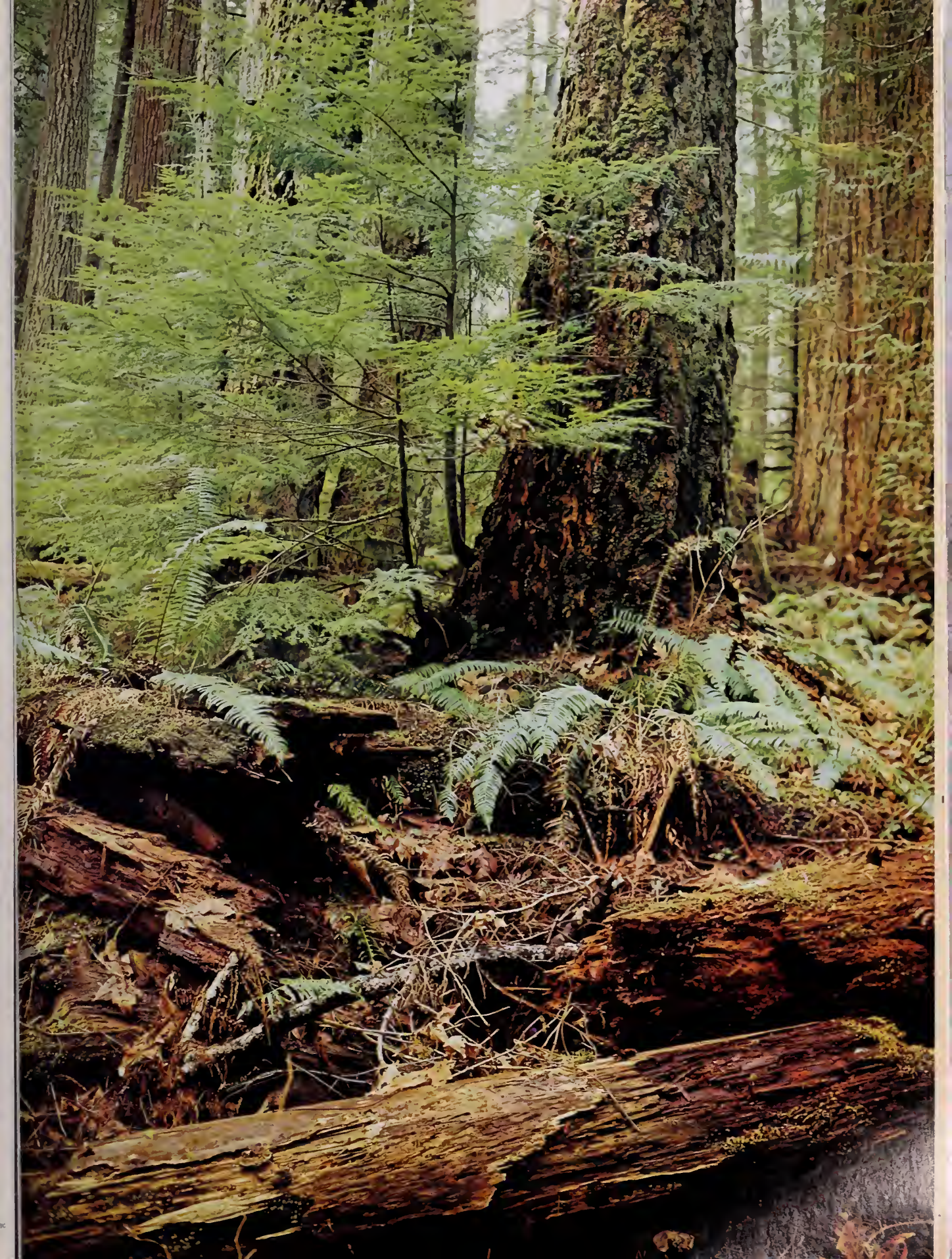
Inspired by the insect community's dual role of architects and janitors of forests, I began a study of dead trees in the Douglas fir forests of western Washington. I started with the idea that the insect community of dead Douglas fir was relatively simple, composed of a couple of dozen species prominent in the literature, but as I read further and dissected more and more dead trees, my list of species grew until it surpassed three hundred. My early elegant diagrams showing the relationships among all the Douglas fir insects grew into monstrous tangles and were eventually discarded. Specimens of insects—identified, unidentified, and unidentifiable—piled up by the thousands. Some of the species had never been described. A simple manual of insects living in dead Douglas fir, a manual I envisioned as a small handbook, swelled to more than six hundred pages. The proposed compact study of a few kinds of bark beetles, a few wood borers, and a termite or two grew into an enormous project easily capable of absorbing a lifetime of research.

The size and complexity of this insect community indicate that insects have found a great many ecological niches in the bark and wood of dead Douglas fir. There are two ways in which insects have carved a multitude of niches in what seems to be a simple resource. First, there is a hierarchy of trophic levels: the phytophagous species, which feed on bark or wood, support parasites, predators, and scavengers. Second, many insects have unique feeding habits due to the nutritional and environmental variables in dead trees.

A good example of a phytophagous species with a well-developed group of associated insects is provided by *Scolytus unispinosus*, a small bark beetle that breeds in the inner bark of recently killed Douglas fir, seldom attacking any other species of conifer. This species is restricted to small trees and branches that are partly or completely exposed to sunlight. Its complex life history is similar to that of many other bark beetles. Host trees or branches are located by a female, which begins boring into the bark, usually taking advantage of the shelter provided by bark fissures or twigs. As the female penetrates the succulent inner bark, she apparently releases one or more odor signals (pheromones) highly attractive to both sexes. Soon after beginning her gallery, she is joined by males and numerous females

Each type of deadwood in a stand of Douglas fir—fallen logs, stumps, and branches—supports a vast array of insects. This faunal complexity multiplies because the different insect communities change as the wood decays.

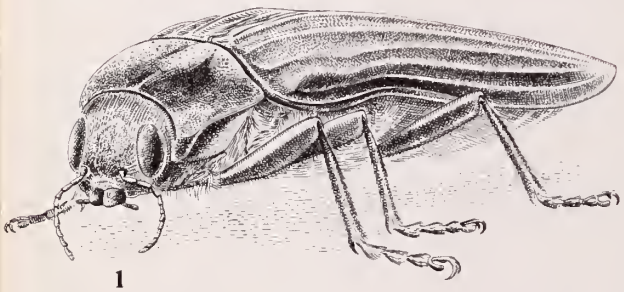
S.J. Krasemann; Peter Arnold, Inc.



The Insect Communities of Dead Douglas Fir

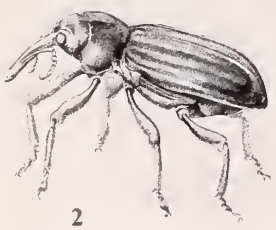
(A Very Incomplete View)

The roots, trunk, branches, twigs, and bark of dead Douglas fir support specialized insects that feed and breed on and in the wood. In the many cases where heartwood or sapwood is preferred, further specialization has taken place. The position of the wood in sunlight or shade is also a determining factor in the composition of the insect community. Each of the insects to which the dead tree plays host is host, in turn, to a variety of predators, parasites, and scavengers.



1

Buprestis aurulenta *(1) is an abundant and conspicuous wood-boring beetle in the Douglas fir forest. Adults feed on conifer needles and mate on injured or recently killed trees. Eggs are laid in bark crevices and in cracks in the sound wood of logs from which the bark is gone. The egg site is usually in partial shade. The larvae feed on sapwood and heartwood and normally require two to four years for development.*



2



3

Pissodes fasciatus *(2) is a weevil that breeds in the fresh inner bark of the trunk. The site has to be shaded and is often on the underside of the trunk. The parasitoid wasp* Allodorus crassipes *(3) attacks the eggs of* Pissodes fasciatus. *Wasp larvae do not kill weevil larvae until the latter are mature.*





Alan Iselin



The bark beetle Pseudohylesinus nebulosus *(4) occurs throughout the geographical range of Douglas fir and is often the most numerous scolytid beetle attacking a stand of these trees. Its abundance is caused by the plentifulness of its hosts—broken tops of live trees, upper trunks of fallen trees, and fallen branches as small as three centimeters in diameter. The species breeds in fresh inner bark that is always shaded, preferring areas that are rapidly losing moisture, through the bark itself or through the transpiration of live needles on adjacent branches.*







Another bark beetle Scolytus unispinosus *(5) has a well-known life cycle. It overwinters as third- and fourth-instar larvae, emerging as an adult between late spring and mid-July. The recently emerged adults feed in the phloem of healthy Douglas fir twigs before beginning their host tree selection flights. They breed in the fresh inner bark of the branches of dead trees that are always exposed to the sun.* Spathius sequoiae *(6) is the largest parasitoid wasp that attacks the larvae of* Scolytus *beetles. Because of the relative shortness of its ovipositor, this wasp can only attack those beetle larvae found near the surface of deadwood. The pinpointing of a host larva might be accomplished through heat perception.* Ecphylus californicus *(7) is a small parasitoid wasp that attacks bark beetle larvae too small to be adequate hosts for other parasitoid wasps. This species is so small, and has such a proportionately short ovipositor, that it can only parasitize host larvae under very thin bark, thinner than is preferred by a bark beetle such as* S. unispinosus.



The longhorn beetle Anoplodera crassipes *(8) often breeds in wood that is old, partly rotten, and at least partly shaded. The beetles remain in the same material for successive generations as the wood decays.*

that begin their own galleries at suitable intervals up and down the tree or branch. The male helps the female excavate a long gallery parallel to the grain of the wood, using a special concave area on the front of his head to scoop out the boring dust. After mating, the male may leave the gallery and go in search of females that have not yet attracted mates. The female remains to lay eggs in small niches along the sides of the gallery. Her supply of forty to one hundred eggs exhausted, the female wedges herself into the gallery entrance where she serves, even after her death, as a barrier to prevent the entrance of young larvae of predators that would eat her young. The beetle larvae feed in galleries extending outward from the egg gallery, each larva doing its best to maintain a thin partition of uneaten bark between itself and its neighbors. In western Washington the larvae overwinter under the bark, pupate in spring, and emerge in early summer in time to start their own galleries in trees and branches downed in winter storms, as well as trees that are showing signs of water stress at the onset of the dry season.

This bark beetle is a common insect and is able to find and colonize almost all suitable Douglas firs. Lifting the bark from a small section of dead Douglas fir, one is almost certain to find a tableau of mother bark beetle guarding the entrance of her gallery and plump white grubs at the end of gradually widening, frass-packed galleries. The tranquillity of this scene is, however, undermined by a series of interlopers. In western Washington I have found twenty-nine insect species in the galleries of *S. unispinosus*. Some of these insects are uncommon in *Scolytus* galleries; these rare insects may be primarily associated with another species of bark beetle or they may be at the edge of their geographical ranges or perhaps their ecological requirements are so restricted that they are seldom abundant. The fourteen species of insects more dependably found in galleries of *S. unispinosus* can be divided into three groups: parasitoids, predators, and associates; the last are composed of scavengers and species whose roles are still unknown.

Parasitoid insects are those whose larvae gradually devour and kill another insect, either working from the inside or the outside. The six common parasitoids of *S. unispinosus* are all tiny wasps, and they all have similar life histories. The female wasp finds a beetle-infested tree, probably locating the site by the odors of resins or alcohol emanating from the galleries of the bark beetles. These species of wasps use their ovipositor to drill through the bark, sting the beetle larva in its gallery, and lay an egg on or near it. The parasitoid wasp larva slowly consumes the host until nothing is left but the hard head capsule and a pellet of crumpled skin. The parasitoid then pupates, transforms to an adult, and gnaws its way out through the bark.



The plumelike tunnels engraved by a brood of Scolytus unispinosus *bark beetles eating their way outward from the vertical egg gallery is a model of efficient use of a rich, but limited, resource. The egg gallery is initiated by the female, which is soon joined by the male. He aids in construction of the gallery by pushing excavated material out the entrance hole. Between 40 and 100 eggs are deposited along the sides of the gallery.*

Alan Iselin

How these parasitoids manage to pinpoint the location of a host larva through the intervening outer bark of the host tree is not known. A much larger species of wasp parasitizing a large bark beetle has been studied by J.V. Richerson and J.H. Borden, and the results of their studies may have some general application. Entomologists originally thought that the female wasp could pick up the vibrations of gnawing larvae, but wasps were shown to be able to locate quiescent larvae. Odor was ruled out by covering a larva with a thin, airtight shield that did

This is for me.



- ◯ I want to join the American Museum of Natural History and get, with my one-year membership, 12 issues of **Natural History** for $15.
- ◯ I want to give a gift of **Natural History** along with a one-year Associate membership in the Museum. Bill me later @ $15.
- ◯ I want to splurge and do both. Bill me later @ $15 per subscription.

I understand that each membership-subscription includes: free admission to the Museum *and* discounts at the Museum Gift Shop.

Send bill to:

My Name _____

Address _____

City _____ State _____ Zip _____

Enter my own subscription, too: ◯ New ◯ Renewal

I prefer: ◯ 2 years at $26 ◯ 3 years at $35

Send gift subscription to: J465

Name _____

Address _____

City _____

State _____ Zip _____

I prefer to give: ◯ 2 years at $26 ◯ 3 years at $35

Please allow 7 weeks for shipment of first copy. Outside U.S.A., add $3 per year for postage.

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO. 30 BERGENFIELD, NJ

POSTAGE WILL BE PAID BY ADDRESSEE

NATURAL HISTORY

P.O. Box 4200
Bergenfield, N.J. 07621

not deter the parasitoid. The investigators finally found a minute difference between the temperature of the bark above the larva and the temperature of the surrounding bark. An artificial warm spot on the underside of a piece of bark elicits initial stages of oviposition behavior by the parasitoid. The sensory receptors involved seem to be a series of microscopic platelets located on the wasp's antennae.

The parasitoids of *S. unispinosus* must know not only the position but also the size of the prospective host larva. A host that is too small produces a miniature parasitoid or none at all. Within the range of host larvae of acceptable size, the smaller hosts still produce parasitoids of subnormal size. Undersized male parasitoids produced from a small host may be at a slight disadvantage when competing for mates and may have a reduced life span due to their small food reserves. Undersized female parasitoids are at a much greater disadvantage because they must use stored food reserves to disperse to a new tree site and produce eggs. Worse yet, the ovipositor length is proportional to the size of the body, so a small female has a short ovipositor that is unable to reach hosts under thicker bark. It would be advantageous for the ovipositing female to lay eggs destined to become males on smaller host larvae and eggs destined to become females on larger host larvae.

My studies of several distantly related parasitoids of bark beetles suggest that the females tend to lay male eggs on small hosts and female eggs on large hosts. The mechanism that determines sex is very simple: all male wasps are haploid, produced from unfertilized eggs, while all female wasps are diploid, produced from fertilized eggs. The mother wasp, like the queen honeybee, controls the sex of her offspring by controlling the release of sperm from a special storage sack that was filled during copulation.

Given the similarities of their life cycles, how can six species of parasitoids coexist on one species of bark beetle? That question cannot be answered completely, but by making notes on the location of parasitoid larvae and then rearing them to adults (the larvae are difficult to identify), I have found several instances of specialization. One parasitoid, *Spathius sequoiae*, and possibly another, *Eurytoma tomici*, usually attack bark beetles living in shaded material. *Cheiropachus brunneri* and *Dinotiscus thomsoni* attack larvae in exposed bark. *Ecphylus californicus* and *Eurytoma phloeotribi* attack young larvae that are too small to be adequate hosts for the other four species. This seems to give *E. californicus* and *E. phloeotribi* a great advantage since they can preempt hosts not yet available to the other parasitoids, but *E. californicus* and *E. phloeotribi* are so small and have such short ovipositors that they can only parasitize hosts under very thin bark, thinner than is actually preferred by *Scolytus unispinosus*.

Predators of *Scolytus unispinosus* are known to include two species of beetles: *Enoclerus lecontei* and *Lasconotus subcostulatus*. Both species are most often found in galleries that the mother bark beetle failed to block with her body. The larva of *E. lecontei* is a large-mandibled, voracious predator that tunnels through the inner bark devouring all bark beetle larvae in its path and probably consuming parasitoid larvae as well. Several *Scolytus* larvae are needed to produce one *Enoclerus*. The larva of *L. subcostulatus* has a different approach, feeding on fungi for its first two larval instars before attacking a *Scolytus* larva. *Lasconotus* behaves almost like a parasitoid, for it slowly consumes a host larva, having first immobilized its prey by stinging it with a pair of caudal organs called urogomphi.

The remaining common associates of *Scolytus unispinosus* include two beetles, four flies, and one wasp. One of the two beetles, *Rhizophagus minutus*, is probably a predator, but it is not known whether this species eats eggs and larvae of *Scolytus* or whether it attacks one of the other associates. The other beetle, *Renardia jubilaea*, and two of the flies, *Sciara* sp. and *Asynapta* sp., feed on a fungus that regularly appears in the galleries of *S. unispinosus*. It is possible that this fungus is a symbiote of the bark beetle, as it has been shown that some other species of *Scolytus* depend on fungi to modify their subcortical environment; these species of *Scolytus*, like many bark beetles, have special cavities, or pits, in which spores of the fungus are carried and nourished with special secretions. One of the fungus-eating flies, an undescribed species of *Asynapta*, is parasitized by an unidentified platygasterid wasp. The remaining species of flies, *Lonchaea corticis* and *Palloptera terminalis*, are primarily scavengers that feed on dead insects such as bark beetle larvae that have died from unfavorable environmental conditions. These flies may actually benefit from the defense of the gallery entrance by the mother bark beetle, for the young maggots often seem to get their start by consuming the internal organs of the dead guardian.

This subcommunity of insects associated with *Scolytus unispinosus* is by no means the most complex of the constellation of subcommunities occurring in dead Douglas fir. *S. unispinosus* has an ecological twin, *Pseudohylesinus nebulosus*, which breeds in the same sort of material but is only found in heavily shaded bark. I have found thirty-three species of insects associated with *P. nebulosus*; most of these do not occur in galleries of *S. unispinosus*. *Dendroctonus pseudotsugae*, the most intensively studied of Douglas fir bark beetles, is known to have forty-three insect associates.

Each of the insects that feeds on bark and wood of Douglas fir has its predators, parasites, and scavengers. The relationship between the associate and its host may be casual, for example, the little *Leptothorax* ants set up their colonies in the abandoned galleries of bark and longhorn beetles. Other relationships are intimate: the wasp *Eubadizon crassigaster* waits with quivering antennae, while the female of the weevil species *Pissodes fasciatus* deposits and carefully covers her eggs in a small excavation in the bark of dead Douglas fir; when the *Pissodes* moves away, the wasp deposits one of her own eggs inside each *Pissodes* egg.

The multiplicity and complexity of relationships between the phytophagous insects and their associates are easily matched by the number and variety of niches that the phytophagous insects use in dead Douglas fir. Specialized habitats have been found by fifty species of bark beetles, twenty-two metallic wood-boring beetles, fifty-two longhorn beetles, six weevils, eight wood wasps, and a dozen or so miscellaneous bark and wood eaters. Careful observation and collecting make it possible to obtain descriptions of the habitats of many species. The longhorn beetle *Phymatodes maculicollis*, for example, usually occurs in recently killed, dry, shaded branches; the false blister beetle *Calopus angustus* may be expected

in soggy, rotting root crowns of small dead trees.

An important factor to dead-tree insects is the portion of the tree available. Root, trunk, branch, twig, bark, sapwood, and heartwood are all grist to the insect mill, but the individual millers are specialists. *Scolytus*, occupying the crown and branches of an exposed dead tree, gives way in the lower bole to the metallic wood borer *Melanophila* and the longhorn beetles *Monochamus* and *Semanotus*, which in turn are replaced in the roots by the bark beetle *Hylastes* and the weevil *Steremnius*. In a cross section of a shaded tree, the bark beetle *Dendroctonus* and the weevil *Pissodes* consume the inner bark, the wood wasp *Urocerus* and the false darkling beetle *Serropalpus* bore in the sapwood, and the longhorns *Opsimus*, *Leptura*, and *Anoplodera* eventually pulverize the heartwood.

Another factor of great importance is the amount of exposure to direct sunlight. A study published by S.A. Graham in 1925 showed that temperatures beneath exposed and shaded pine bark can differ by as much as 35°C. The great temperature extremes in exposed bark combine with accelerated drying and chemical decomposition to make exposed bark and wood a special habitat that must be exploited by specialized insects.

The time elapsed after the death of the tree or branch also determines the composition of its insect community. The bark feeders—rapidly nourished by the abundant and relatively easily digested nutrients of the inner bark—arrive first and leave first. Sapwood feeders begin to arrive at almost the same time as the bark feeders, and in fact many sapwood feeders enrich their diet with inner bark while deeply engraving the surface of the sapwood. Sapwood feeders often require a year or more for development. Insects that feed in rotting sapwood and in heartwood persist for many years, often producing several generations over a period of twenty years or more. Several years after a tree's death there is little left but cellulose and lignin, both materials resistant to digestion. Accumulated resins may make the heartwood still more intractable. Many insects that feed in wood of dead trees are actually unable to digest much wood and derive their nourishment from fungi that permeate the wood.

The fungal flora of the dead tree is one of the most important determinants of the insect fauna, and the insects are often vectors of the fungi. There are many examples of symbiosis, as in the case of the wood wasps, which actually inject fungal spores into the wood along with the egg, or the ambrosia beetles, which cultivate special fungi along the galleries and chambers excavated in the wood. In many other cases insects seem to be associated with wood invaded by certain types of fungi, but the exact relationship between insect and fungus is not known. The fruiting bodies of shelf fungi have distinctive insect faunas separate from the group of insects that feed in wood filled with the hyphae of these fungi.

The insect community of a dead tree is also determined by the season when the tree became available for colonization. When I cut a series of Douglas fir trees at regular intervals, starting in early spring and ending in late fall, I found that trees cut during spring and most of the summer were regularly invaded by the bark beetles *Dendroctonus* and *Pseudohylesinus* and by the weevil *Pissodes*. Trees cut in August and September missed the flight season of these beetles, and by spring the bark had fermented so extensively that it was no longer suitable for insects that feed on fresh bark. These fermenting trees became enormously attractive to the ambrosia beetles *Gnathotrichus* and *Trypodendron*, which are attracted by alcohol. The sapwood of fall-killed trees is quickly riddled with the galleries of three species of ambrosia beetles, which build long, branching galleries lined with a black fungus. The larvae of ambrosia beetles live in small niches, called cradles, and feed on the fungus growing on the walls of the cradle or on a special pellet of fungus supplied by the adults. Wood that has been attacked by ambrosia beetles is filled with pinholes, each surrounded by a black stain associated with the fungal hyphae. Such wood has lost much of its economic value.

Regional factors, too, may determine which insects invade a dead tree. The geographical ranges of many Douglas fir insects are determined by climatic and historical factors, so that insects present in a dead Douglas fir in the mountains of New Mexico are often different from those that are found in western Washington. The insects found in dead trees of one species may be influenced by the regional abundance of hosts of another species. For example, the bark beetle *Orthotomicus caelatus* attacks Douglas fir but is more common in pines; in areas of western Washington where lodgepole pine is abundant, *Orthotomicus* regularly seems to spill over into Douglas fir; but where lodgepole pine is absent, *Orthotomicus* is quite rare. Some insects attack one host in one region and another host in another region: over most of its range the bark beetle *Pityokteines elegans* breeds in pine and true fir, but in northern Idaho *P. elegans* abruptly begins to attack Douglas fir.

All organisms tend toward ecological specialization as they evolve adaptations to enable them to exploit specific resources. This tendency toward specialization is counteracted by the necessity of maintaining a large enough resource base to insure survival. The insect community of dead trees demonstrates the compromises organisms must make between the efficiency of specialization and the benefits of a large, diverse resource base. As described above, there are many environmental and nutritional factors that can be bases of specialization.

WHEN YOU WRITE TO NATURAL HISTORY

about a change of address, renewal of subscription, billing, or any kind of adjustment, send the present address label from the magazine wrapper.

Moving? Please notify 6 weeks in advance. You can use this form to tell us about a move or order a subscription.

Change of address—Attach your address label in the dotted area and fill in your new address below, clip and mail to Natural History Membership Services, P.O. Box 4300, Bergenfield, N.J. 07621.

Cut your old address label from magazine wrapper and attach over this area.
Fill in your NEW address and mail to:
Natural History Magazine
Membership Services P.O. Box 4300
Bergenfield, N.J. 07621

PLEASE PRINT

Name _____

New Address _____

City _____ State _____ Zip _____

In most forests, however, there is a limited amount of deadwood and bark that becomes available each year through wind breakage, shading out, fire, and attacks by animals and disease.

The usual way dead-tree insects maintain a diverse resource base is by using several species of host trees. Insects that breed in dead Douglas fir usually also use true firs and spruces; many occur in pines, hemlocks, and larches, some in cedars, and a few in broadleaf trees. Similarities in the insect faunas of dead trees can reflect not only morphological and chemical relationships but also the frequency with which different tree species live together in natural mixed stands. Insects with very poor mobility, such as the flightless longhorn beetle *Plectrura*, may be expected to use a great variety of hosts. Species of insects that breed in only one species of tree show not only great mobility but also a tendency to attack very fresh or even living trees. Those insects that attack live trees have enlarged their resource base because they are no longer dependent on external factors such as windstorms to produce a supply of dead material. These observations about the size and configuration of the ecological niches in dead trees are far from complete, but they at least give glimpses of an intricate order that is imposed even upon decomposition.

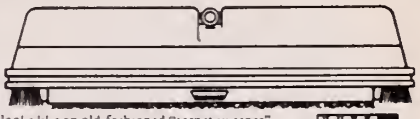
What can be achieved by a study of the insect fauna of dead trees, what, that is, beyond an odd compulsion to hastily pick apart pieces of wood before putting them on the campfire? One benefit is a more complete, much more balanced view of some insect pests that are normally only studied in the context of economic damage. Then there is considerable satisfaction in adding to our knowledge of insect fauna. It is very easy to obtain original information when looking at a community as poorly known as the insects of dead trees; I have found undescribed species of insects in Douglas fir in city parks in Seattle. Finally, there is a new vision of the deadwood in forest and woodlot, deadwood that is no longer the very symbol of unproductivity, but rather a complex, meticulous recycling station that deposits minerals and humus on the ground, while pouring forth the stored energy of the tree in a swarm of organisms indispensable to forest food chains. □

SALE! Thousands sold at ~~$24.95~~ ~~$22.95~~ NOW $19.88 with coupon below!

TIRED OF BUYING JUNK?

GET A Carpet Cat®

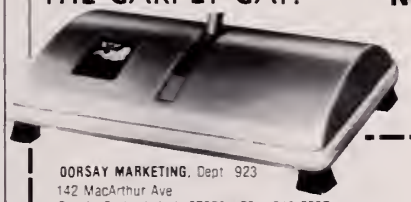




The CARPET CAT is built with care by people who make nothing else, for people who believe household appliances should last a lifetime. We also think appliances should be noiseless, convenient, pretty, efficient and require no electricity.

If you feel the same way, you're going to love a non-electric CARPET CAT floor and carpet sweeper. We believe it is the lightest, strongest, most efficient and convenient appliance of its type on earth. In the past 6 years, thousands of commercial users worldwide (airlines, hotels, restaurants, etc.) have confirmed our belief by demanding only our floor sweepers. A CARPET CAT weighs under 3 pounds, is only 9 inches wide and works as well on a bare floor as it does on carpet. It picks up sugar, sand, pet hairs, paper clips, ashes and much more. Who really needs a vacuum cleaner?

THE CARPET CAT:



Yes, it looks like an old-fashioned "carpet sweeper" (except it is far smaller and about ⅓ the weight), but there the similarity ends. The CARPET CAT is patented and based on entirely new technology. Its natural hog bristle brush will outlast synthetics by about 3 to 1. It should last a lifetime if properly cared for in ordinary household use. The CARPET CAT'S baked enamel surface wipes clean with a damp cloth. Horse hair corner brushes clean right up to the wall, and the whole sweeper can be hung up in 2 inches of wall space. EVERY PART IS REPLACEABLE AND CARRIED IN STOCK.

If you can find any other sweeper that can make the above claims, BUY IT. We are sure you can't, so we want you to try our CARPET CAT.



Pick up unexpected messes in seconds.



Clean stairs quickly and easily.



Reach hard-to-get-at-places.

NO NOISE, NO HOSE, NO ELECTRIC CORDS

Only $19.88 plus $3.50 for ship./hand

SATISFACTION GUARANTEED or return for refund of purchased price

MASTER CHARGE & VISA CUSTOMERS DIAL 1-201-546-5507

DORSAY MARKETING, Dept. 923
142 MacArthur Ave
Box A Garfield, N.J. 07026 • (201) 546-5507

Please send me_____Carpet Cats at $19.88 each plus $3.50 heavyweight shipping, handling and insurance

SAVE! Order 2 Carpet Cats for $39.50 plus $5.50 heavyweight shipping, handling and insurance

SAVE MORE! Carpet Cats make great gifts. Order 4 for $78.60 plus $6.75 heavyweight shipping, handling and insurance

Enclosed is $_____ (NJ residents add 5% sales tax)

CHARGE IT: ☐ MC ☐ Visa Exp. date_____

Card#_____

Signature_____

Name_____

Adress_____

City_____State_____Zip_____

© 1980 Dorsay

Famous Olde Time 5-Speed

Electric Ceiling Fan



The Charm of a Bygone Era—PLUS Up-to-the-Minute Practicality!

Similar to models selling elsewhere for $199 and more.

Distributes Cool Air in Summer, Warm Air in Winter!

48" Across

ONLY $89.

$10.00 Below Our Own Nationally Advertised Price.

LOWEST PRICE EVER! A nostalgic wooden-paddle fan to grace your casbah. It's quiet-running, energy-efficient, and dramatically decorative. Perfect for home, shop, office.

Ceiling fans have been in use for over a hundred years—And with the energy crunch, they're more practical than ever. In summertime, air conditioners can be set warmer to save electricity, and you'll still get a refreshing cool feeling. In winter, the ceiling fan saves on fuel bills—recirculates warm air downward.

The all-season ceiling fan has metal base, trouble-free motor, weight-balanced, mahogany-finish, wooden blades, stylish brass trim, 5-speed wall-mounted switch. Easy to install; measures 48" across. (UL and CSA listed.)

Z5145540 . . . Ceiling Fan $89.00

OUR GUARANTEE: You must be absolutely delighted. If not, simply return within 30 days for a prompt full refund of purchase price . . . No questions asked! We ship within 48 hours; delays notified promptly. Delivery guaranteed within 60 days.

SATISFACTION GUARANTEED! ORDER TODAY!

OLD VILLAGE SHOP, Dept. VZ-7287, 340 Poplar St., Hanover, PA 17331

Yes! Please rush my Electric Ceiling Fan(s) (Z5145540) as indicated below, on Full Money-Back Guarantee.

☐ One Ceiling Fan only $89.00 (plus $5.25 heavyweight shipping & handling).

☐ SAVE! Two for just $175.00 (plus $10.00 heavyweight shipping & handling).

Enclosed is $_____(PA res. add sales tax)

CHARGE IT: ☐ American Express ☐ Diners Club ☐ VISA ☐ Carte Blanche ☐ Master Charge

Account No._____ Exp. Date_____

PRINT NAME_____

ADDRESS_____

CITY_____

STATE_____ZIP_____

© Old Village Shop, 1980

A Sad Reflection of the Outside World

by Ian Tattersall

A World Like Our Own: Man and Nature in Madagascar, by Alison Jolly. *Yale University Press, $29.95; 272 pp., illus.*

Madagascar, as the title of Alison Jolly's new book elegantly hints, is another world; if any place deserves the much abused title of "unique," this is it. The thousand-mile-long microcontinent possesses almost every type of biological community found elsewhere in the tropical world. But on Madagascar, which has been separated from its parent continent, Africa, for upward of a hundred million years, each community is strikingly different. Rates of endemism—of uniqueness of species—are extraordinarily high, and in the aggregate, this translates into a remarkable singularity of gestalt.

Way back, the great island formed part of ancient Gondwanaland, the vast landmass that broke up to give us the southern continents we know today. At that time Madagascar shared the same pantropical flora and fauna with its neighboring regions. But since the breakup, which took place before the great periods of diversification of many important biological groups, including the flowering plants and the mammals, the flora and fauna of Madagascar have been free to evolve in relative isolation from the outside world. I say "relative" isolation because not all the plants and animals in Madagascar today are descended from those living on the island at its separation from Africa. Immigrants have crossed the water barrier from time to time, although most of these apparently did so at an early stage; recent arrivals such as the now extinct pygmy hippo seem to be the exception rather than the rule.

The upshot of this history of isolation and highly selective invasion is an extraordinary natural experiment that tells us, in Jolly's words, "which rules would still hold true if time had once broken its banks and flowed to the present down a different channel." The founding species of the modern Malagasy biota were presented with virtually all of the ecological opportunities available at similar latitudes elsewhere, and the descendants of this restricted spectrum of species have radiated to fill this vast ecological space. There are relatively few major animal groups living in Madagascar, but most of those present are represented in great adaptive variety, producing, from different roots, entire ecological communities that parallel those existing outside. Take, for example, the lemurs, the subjects of Jolly's own specialized studies in Madagascar. These primates, members of a suborder represented elsewhere only by a handful of small, nocturnal genera, display in Madagascar a full and fascinating adaptive spectrum within which remarkable parallels to other animals are found. For instance, not only did the lemurs evolve baboonlike diurnal ground-living quadrupeds and a large, orangutanlike arboreal hanger, but they also produced their own ecological equivalent of the woodpecker, the Malagasy aye-aye.

Sadly, however, Madagascar reflects the outside world in another way, too, and this is what *A World Like Our Own* is essentially about. Although it was the last major inhabitable landmass to have been invaded by humans, Madagascar is already one of the most devastated. Less than two thousand years ago, teeming forests covered virtually the entire face of the island. Now, thanks to the twin assaults of ax and fire, the forest protects a mere few percent of the land area, and the island's lifeblood, its soil, bleeds steadily away to the sea. Already entire vegetal formations have disappeared; many of the most fascinating animal species of Madagascar are gone forever. The pseudobaboon and the pseudoorangutan, for example, are known today only from their subfossil bones; the "woodpecker" hangs on by the merest of threads. It is easy to separate those species still living and those now extinct into separate compartments of the mind. But in Madagascar the division is an unreal one; both the living and the extinct are participants in the same process: human destruction of nature. And it is with this process that Alison Jolly is above all concerned. Individual species, even those most lovingly described, appear almost as incidental characters in her book; the conflict between man and nature is the predominant theme.

Jolly recounts the story of a five months' journey through Madagascar. She has done almost everything, been almost everywhere. She has climbed mountainsides through dripping rain forests in the company of cut-and-burn farmers and has contemplated ruffed lemurs bouncing through the treetops; she has held earnest conversations

FROM THE STATE OF VERMONT... COMES THE STATE OF THE ART



The VIGILANT, our middle-size stove. Shown here as a free-standing unit, it may also be enjoyed in a fireplace installation, providing a friendly fire of crackling logs with doors open — a superior heating unit with doors closed.

Vermont Castings Defiant, Vigilant and Resolute are truly American Classics. From the original Defiant, our largest model, to the Vigilant and Resolute, every stove is built with the conviction that beauty and efficiency can be combined without compromise. Crafted by hand in solid **cast iron,** these superb **airtight** stoves offer you a lifetime of dependable, economical heat. The unique and graceful curve of the stove front, with its classically arched doors, is your symbol of original Vermont Castings design.

A significant new breakthrough in wood to coal convertibility. The Vermont Castings Vigilant and Resolute are designed to burn either wood or coal with equally high efficiency. Our advanced thermal engineering and unique "stove within a stove" design make it possible.

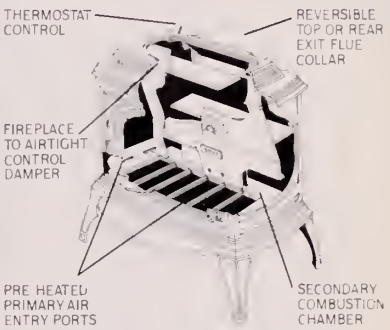
There's no fear of making a costly mistake in your choice of fuels — now, or later. Our optional coal conversion unit gives you the flexibility of using either wood or coal, whichever provides the greatest economy and meets your personal needs. Best of all, you can add the conversion unit at any time.

Each model offers every feature knowledgeable stove enthusiasts demand. Vermont Castings stoves make use of sophisticated baffling systems to provide extremely long flamepaths, minimizing flue heat loss. Pre-heated air passages and true secondary combustion chambers maximize heat and fuel economy.

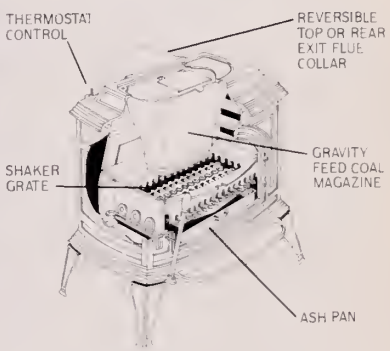
Automatic thermostat control allows you to pre-set your stove at the desired level of heat output to burn slowly and evenly all night long on a single smokeless loading.

Before you buy any stove, mail coupon today for our complete ENERGY-SAVER INFORMATION KIT. Compare . . . then decide.

Classic Beauty and Advanced Thermal Engineering Combined in America's Finest Cast Iron Stoves

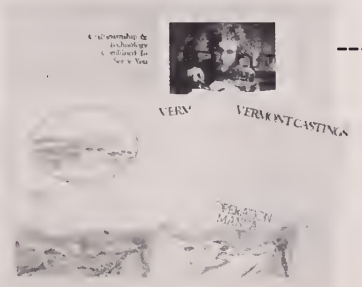


The Wood-Burning VIGILANT



The Coal-Burning VIGILANT
"Our stove within a stove"

	The DEFIANT	The VIGILANT	The RESOLUTE
HEAT OUTPUT	55,000 BTU's/Hr	47,000 BTU's/Hr	35,000 BTU's/Hr.
AREA HEATED	8,000-10,000 Cu Ft	6,500-8,500 Cu Ft.	5,000-7,000 Cu Ft.



☐ YES, please send me, without obligation, your Information Kit including full color literature and Operation Manual. I enclose $1 for first class postage and handling.
I heat my home by: ☐ Oil ☐ Gas ☐ Electricity ☐ Wood ☐ Coal

Name _____

Address _____

City / State _____ Zip _____

Vermont Castings

DEFIANT® VIGILANT® RESOLUTE™
America's Finest Cast Iron Stoves

VERMONT CASTINGS, INC. 2065 PRINCE ST., RANDOLPH, VT 05060 • TELEPHONE: (802) 728-3111

© 1981 VERMONT CASTINGS, INC.

Russ Kinne; Photo Researchers



Small ears and a pointed, foxlike muzzle are characteristic of the sifaka, one of the many lemurs found in Madagascar.

with central government officials in the capital and has commiserated with beleaguered foresters in the field; she has talked with a king on his off-hour from operating the police station switchboard and has picked wickedly barbed thorns from her skin in the spiny, arid forests of the south. All of this, and much more, she reports in a marvelously evocative way. If you never visit Madagascar yourself, or perhaps even if you do, you are unlikely ever to know it better than you will through the pages of this book. For those who like their images visual, there are a hundred black-and-white photographs by Russ Kinne. They provide an excellent complement to the text, but one still regrets the dearth of color photographs. By their isolation, the six that have found their way into the book simply emphasize the lack of others.

But *A World Like Our Own* is, as I have suggested, much more than mere travelogue. It tells two parallel stories: that of the decimation by humans of the Malagasy flora and fauna and that of the Malagasy peasant's struggle for survival. Both stories are moving, and both are movingly told. Jolly sees the destruction of Madagascar's treasurehouse of plants and animals and is deeply concerned. But she also sees the plight of the peasant who must feed and shelter his family, and who cannot afford to think of tomorrow when today's needs are so pressing. And she sees beyond both of these things: that while for the moment further forest destruction will keep the peasant and his family alive, ultimately there will be no more forest to destroy, and the peasant will have to find some method other than cutting-and-burning to earn his livelihood or starve. But what? For with the disappearance of the forest come the disappearance of nutrients from the soil, the disappearance of the soil from the slopes, and the disappearance of the water from the streams. This is no mere doomsday extrapolation to something that may happen if present trends continue unchecked—it has already happened over much of the island. Not for nothing has Madagascar been described as an island the "shape, color and consistency of a brick." I remember my own reactions upon flying over Madagascar for the first time: the landscape below looked brown, dead, forlorn. How, I wondered, could this possibly be the home of the most fascinating forest fauna on earth? Cut, burn, plant, harvest, and move: this has been the human pattern on Madagascar for centuries. But in the past there was much more forest; in the past the island was not home to nine million people, half of them under twenty.

All of this Alison Jolly sees, describes, understands. But if there is one flaw in this charming, tolerant book, it is that it is too charming, too tolerant. Jolly's sympathy is almost too complete. It is somewhat as if she were describing a Garden of Eden in which eating the apple had itself become a sacramental act. She was sent to Madagascar by the World Wildlife Fund, an organization presumably devoted to saving other species from extinction rather than to preserving the life style of peasants.

Yet there is nothing in the book of the sense of helpless outrage that so often engulfs one in Madagascar, and something akin to that has to lie at the heart of the activities of conservationists everywhere. Of course, such emotion has to be balanced by pragmatism, by a sense of reality; but if it is overbalanced, we are paralyzed. There are places in the eastern humid forests of Madagascar where one can stand on a mountain crest and see the rain forest stretching away, ridge and valley, for as far as the eye can discern. Its very immensity creates an almost tangible presence, a sense of permanence, of inviolability, as if this were how the world had from the beginning been meant to be. Then, by turning one's head no more than ninety degrees, one sees devastation: clearings, vast and small; spirals of smoke rising lazily into the air, signaling the imminence of the end of what still remains. And one doesn't want to understand. One doesn't sympathize.

For if one did, if one really understood the human needs that underlie such devastation, could one really seek to stop it? The destruction is not wanton; its causes lie far beyond what could be achieved by a few conservation-oriented grants, while a Third World government beset by the immediate problems of feeding an ever expanding population can hardly afford to take a long-term view. Successful conservation under these conditions requires a certain degree of monomania, a refusal to acknowledge the full, daunting dimensions of the problem. Alison Jolly's book is less than satisfactory as a conservationist tract precisely because it reminds us so clearly of the difficulties involved, the more powerfully since it presents them at an intimately human level. And as its title reminds us, the problems are not Madagascar's alone. The island is indeed a microcosm, and both despite and because of its shortcomings as a tract, this sensitive book should be read by all who are concerned about conservation worldwide. And by others, too, for it is the finest modern evocation in our language of the unique, fascinating, and unfamiliar world of Madagascar.

Ian Tattersall is associate curator in the Department of Anthropology at the American Museum. He has traveled and worked extensively in Madagascar, where he has studied various aspects of the biology of lemurs.

Fine art. Fine value.



"Femme Bleue," an original lithograph by Linda Le Kinff, typifies the very remarkable value that Christie's Print Collection offers in original etchings and lithographs. Attractive landscapes and figurative works by rising young artists from $100 to $150. As well as the work of such masters as Chagall, Moore and Miro.

Each work is an original, numbered and signed by the artist. Then it is stamped with Christie's seal of authentication and delivered to your home.

Let us send you our free colour portfolio and price list. There's no better place to buy original prints. No better time than now.

Christie's Print Collection

For free colour catalogue and price list mail to:
Christie's Print Collection
Expediters, 527 Madison Avenue, New York, N.Y. 10022

Name_____
(Please Print)
Address_____
City_____ State_____ Zip_____

NH 1 03 81J



Why take these 5 costly power failure risks?...

1. Spoiled food thawing in your freezer
2. Flooded cellar when your sump pump fails
3. Frozen pipes that burst
4. No water for washing, cooking
5. No lights, no warmth, no comfort

THE NEW 2in1 **Garden Way GENERATOR**

Frees you from these worries and costs. This rugged, reliable machine attaches directly to your house wiring, restoring essential power. and... IT'S PORTABLE TOO!



Garden Way Generators,
c/o Garden Way Research Dept. A1016G Charlotte, Vt. 05445

RUSH ME FREE DETAILS about the versatile 2-in-1 Garden Way Generator, including a POWER RATER WORKSHEET to figure my home energy needs.

Name_____
Address_____
City_____
State_____ Zip_____

© 1981 Garden Way, Inc.



Not *only* birds do it!

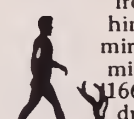
The *Mystery* of MIGRATION



DR. ROBIN BAKER,
Chief Contributing Editor



Explore the startling new theories of why and how every living thing, from plant spores to man himself, takes part in the miraculous process of migration. 360 color, 166 b&w photos; maps; drawings.





"A comprehensive study of an utterly fascinating subject."
—Publishers Weekly



THE VIKING PRESS,
Dept. ATE-NH
625 Madison Ave.,
New York, N.Y. 10022

Send me ____ copies of THE MYSTERY OF MIGRATION @ $29.95. Add sales tax where applicable and $2.00 per copy for shipping. I enclose $____ total.

Name_____
Address_____
City_____ State_____ Zip_____

THE MARKET

Art

AMERICAN INDIAN CRAFTS: Pueblo pottery; Hopi 2nd and 3rd Mesa plaques; Kachinas, old and new rugs. No catalogue. One-of-a-kind pieces; individually photographed. Most priced $100/up. Write for photos and data, specifying interests. Box 5896, Sherman Oaks, CA 91413 (213) 789-2559

BRITISH BRASS RUBBINGS. Portraits of the English nobility of the past. Rubbings of old monumental church brasses. Individually handmade. Illustrated catalogue $1 (refundable first order). Godolphin, 6910 E. Mesa Grande Drive, Tucson, AZ 85715

COLORFUL FLAMING DEMON GINIJALA MASK, Sri Lanka, $22.00, request photo, McCoy Imports, Liberty, NY 12754

NOW YOU CAN own world-famous poster art! Lithographic recreations . . Write: Posters, Box 573-N, Hicksville, NY 11801

PET PORTRAITS AND WILDLIFE ART. Acrylic ink, ceramics. Animal Art, Box 335, Route 4, Spotsylvania, VA 22553

THE FLYING EAGLE®: The ultimate Bald Eagle photograph. Acclaims by "Alaska" Magazine & "Audubon." Bird gliding gracefully at me against brilliant blue sky, looking me directly in the eye, beak open talking to me. 16 × 20 fine art print, $15. Deluxe greeting cards, European quality panoramic postcards, ultra-quality stationery. Sample correspondence packet, $2. Ken Hunter, Egegik, Alaska 99579



Back Numbers

NATIONAL GEOGRAPHICS, 1888 - 1980, Issues, Book Publications, Collectors Items. Send Wants. Buxbaum Geographics, Box 465-NH, Wilmington, DE 19899

Book Publishers

PUBLISH YOUR BOOK! Join our successful authors. Publicity, advertising, beautiful books. All subjects invited. Send for fact-filled booklet and free manuscript report. Carlton Press, Dept. NHC, 84 Fifth Avenue, New York 10011

Books

BOOKFINDING. Librarians search worldwide titles or subjects plus 150,000 indexed stock. PAB, 2918 Atlantic, Atlantic City, NJ 08401 (609) 344-1943

OUT-OF-PRINT, SCARCE, Zoology, Botany, Ornithology, Colorplate, etc. Catalogue $1. Book Chest, 19 Oxford Place, Rockville Centre, NY 11570

PUBLISHERS' OVERSTOCKS, BARGAIN BOOKS. 2,000 titles, all subjects! Free catalogue: Hamilton, 98-55 Clapboard, Danbury, CT 06810

SOUTH AMERICA BOUND? We've got detailed guidebooks, maps for travellers. Europe, Asia too. Send for free catalogue. Bradt Enterprises, 54-N Dudley, Cambridge, MA 02140

TEACH YOURSELF STAINED GLASS, send $10 for 2 volumes to Stained Glass Primer, Dept. SGN, 10033 Broadway Terrace, Oakland, CA 94611

"TROPICA"—Cyclopedia of Exotic Plants, 7,000 color photos, 1,136 pages, $115. Request circular. Roehrs, Box 125, E. Rutherford, NJ 07073

Camps

Boys 9-16

Farragut Naval Camps

Give your son a summer to remember! Boating & fishing trips. 50-boat fleet with 25 sailboats. All sports. 2 gyms, 3 athletic fields. Outdoor pool. Approved summer school. Opens July 5. Catalog. Also winter school at Farragut Academies in NJ and Florida. Grades 5-12. Farragut Naval Camps. Box ZC, Toms River, NJ 08753 • (201) 349-1121.

NATURAL SCIENCE CAMP in Ontario. . . . Co-ed, ages 9-14. Serious nature study plus wilderness canoe tripping. Banding birds, collecting minerals, investigating marshes plus swimming and canoeing instruction. Small informal groups. Blue Heron, Box NH, 511 Morris Place, Shillington, PA 19607

Collectors' Items

BIRDS ON POSTAGE STAMPS from many countries. 25 different 35¢. Free list. Geo. Ford, P.O. Box 5203-N, Gulfport, FL 33737

LETTERS FROM THE GOLD RUSH. First hand accounts from 1849. 42p. $3. Bob Sherman, Box 92, River Grove, IL 60171

RECEIVE VALUABLE MINERALS MONTHLY! Write today! Free Details! Mineral of the Month Club, 13057-H22 California, Yucaipa, CA 92399

70 - 110 YEAR OLD MAPS. All States. Stamp for Catalogue. Northern Map, Dept. HN, Dunnellon, FL 32630

Correspondence

FOR CHILDREN: Letters from A Woodsman. Educational, meaningful. Details, sample: Box 1003, Libby, MT 59923

MAKE FRIENDS WORLDWIDE through international correspondence. Illustrated brochure free! Hermes-Verlag, Box 110660/NH, D-1000 Berlin 11, West Germany

ORIENTAL WOMEN SEEK CORRESPONDENCE for cultural exchange, language practice, friendship. Asian Exchange, Honokaa, Hawaii 96727

Education

EXPLORE MICROSCOPIC WORLD—algae, protozoans, blood cells, etc. New Science Course for all ages. How to purchase and use a microscope with free brochure. Life Sciences, Box 591M. Woodbury, NJ 08096

FIELD COURSES IN NATURAL HISTORY. College Credit. Write Aspen Center for Enviromental Studies, Box 8777A, Aspen, CO 81612

Employment Opportunities

AUSTRALIA NEEDS YOU! Jobs! Paid Transportation! Newest handbook, $2.00 (guaranteed). Australian International Services, Box 19107-RO, Washington, DC 20036

AUSTRALIA—NEW ZEALAND NEED YOU! Big Pay! 50,000 jobs. Free transportation. Latest listings $2.00. Austco, Box 772, Cypress, CA 90630

AUSTRALIA . . NEW ZEALAND WANT YOU! 17,500 Jobs! Paid Transportation! New Report! $2—Moneyback Guarantee! "Australia Commission," Department 894-C3, National Press Building, Washington, D.C. 20045

FREE DETAILS—OVERSEAS JOBS! All occupations! 68 countries. Paid fare. Computerized reports. Jobworld, Box 681, Cypress, CA 90630

JOBS OVERSEAS (Including Alaska Gas Pipeline). Free Details. Global Employment, Box 808-NH, National City, CA 92050

OVERSEAS—ALL OCCUPATIONS! Worldwide Directory and complete information—$3.00. International Opportunities, Box 19107-RO, Washington, DC 20036

ROCKY MOUNTAIN EMPLOYMENT NEWSLETTER! Colorado, Idaho, Montana, Wyoming! Current openings—all occupations! Free details . . . Intermountain-4Y, 3506 Birch, Cheyenne, WY 82001

TEACHERS - ADMINISTRATORS: School, college job openings: USA, $5.95; Abroad, $5.95. Placement, sources USA, $4.95; Abroad, $4.95. EISF, Box 662, Newton, Massachusetts 02181

Financial

VENTURE CAPITAL for your start-up or young company. No up-front fees. Kent, (212) 964-1142, Suite 416, 111 Broadway, NYC 10006

Foreign Newspapers

WORLDWIDE ENGLISH NEWSPAPERS. 65 countries including Thailand! Sampler: 5/$2.98. Free Brochure. Multinewspapers, Box DE-203, Dana Point, CA 92629

Gourmet Interests

ELEVEN FAVORITE LIQUEUR recipes. Copyrighted. Easy. Economical. Excellent as gifts. SASE. $2.00. LuArt, Box 130, San Luis Rey, CA 92068

GOOD FOOD—GOOD FOLKS BOOK of vegetarian recipes, tips and anecdotes from across America. Send $3.50 to Kona Printing, P.O. Box 3117, Plainfield, NJ 07063. Moneyback guarantee.

THE BEST: Brownies, Sunshine Cake, Tipsy Chicken or dollar refunded. Box 61, Newcastle, NH 03854

THREE AUTHENTIC SOUTHERN "Red-Neck" recipes. Chicken-bog, fish stew, cheese grits. $2.00. SASE, 905 47th Avenue, Myrtle Beach, SC 29577

Government Surplus

"GOVERNMENT SURPLUS DIRECTORY." Buy 500,000 items (including Jeeps) . . . low as 2¢ on dollar! Most complete information available-$2.00. Surplus Disposal, Box 19107-RO, Washington, DC 20036

SURPLUS JEEPS—$19.30!—CARS—$13.50!—650,000 Items!—Government Surplus—Most Comprehensive Directory Available Tells How, Where To Buy—Your Area—$2—Moneyback Guarantee—"Government Information Services," Dept. DC-3, Box 99249, San Francisco, CA 94109

SURPLUS LAND FROM $3.50/ACRE!—New Buyer's Guide shows how!—Vacation!—Investment!—$2 Moneyback guarantee! "Surplus Lands Bureau" 894-E3 National Press Building, Washington, DC 20045

Merchandise

FREE CATALOGUE. Distinctive merchandise for discriminating people. We have Wildlife Prints by the renowned James Lockhart, Austrian backscrubbers, Peoplefeeders, Norwegian Footwear Dryers, Admirals Lamps, things for the den, more. The Armchair Emporium Ltd., 825 Surrey Lane, Dept. NH2, Algonquin, IL 60102

"I LIKE IT WILD® . . . " Wilderness/wildlife posters, T-shirts, notecards. Send stamped envelope: Wilderness Dreams®, Box 4455-N, Shawnee Mission, KS 66204

PURCHASE BOWIE, Civil War knives, Indian tomahawks. Robert Abels, 2881 N.E. 33 Court, Fort Lauderdale, FL 33306

Optical

BINOCULAR SALES AND SERVICE. Repairing binoculars since 1923. Alignment performed on our U.S. Navy collimator. Free catalogue and our article "Know Your Binoculars," published in Audubon Magazine. Mirakel Optical Co., Inc., 331 Mansion St., West Coxsackie, NY 12192 (518) 731-2610

Periodicals

MAGAZINE FOR COUNTRYSIDE PEOPLE! Covering: Small stock, gardening and more . . . Only $8. - One year - Farming Uncle, Box 91-H, Liberty, NY 12754

Photography

CASH WITH YOUR CAMERA! Earn $5,000-$15,000 yearly selling to 4000 clients. Sell nature photos 15 or more times. Guaranteed details - 25¢. Pictureprofits, Box 479-NH, Port Jefferson Station, NY 11776

Real Estate

FREE! Big Spring Catalogue! Over 5,400 country properties described, pictured! Land, Farms, Homes, Businesses, Recreation, Retirement buys! Selected best thruout the U.S. Over 700 offices, 43 states All Across America! Yours Free from the World's Largest! Strout Realty, Inc., 60 E. 42nd Street, Dept. 5390, New York, NY 10017

FREE . . . 296-PAGE CATALOGUE. Describes and pictures over 2,800 farms, ranches, acreages, businesses and town and country homes from coast to coast. United Farm Agency, Inc., 612-V W. 47th St., Kansas City, MO 64112. Ph. Toll-Free: 1-800-821-2599; MO. Res. Ph. Toll-Free: 1-800-892-5785

GOVERNMENT LANDS . . . FROM $7.50/ACRE! Homesites, farming, vacationing, investment opportunities! "Government Land Buyer's Guide" plus nationwide listings—$2.00. Surplus Lands, Box 19107-RO, Washington, DC 20036

Recordings

OLD TIME RADIO PROGRAMS on cassette tapes. Free catalogue. Cassette Library Center, P.O. Box 5331H, Baltimore, MD 21209

RECORDS—TAPES! Discounts to 73%; all labels; no purchase obligations; newsletter; discount dividend certificates; 100% guarantees. Free details. Discount Music Club, 650 Main St., Dept. 25-0283, New Rochelle, NY 10801

Rentals

ADIRONDACK LODGES on Upper Saranac Lake. Available for two weeks or a month, July through September. Everything provided for comfortable living in the quiet woods. From $650–$1,700 for two weeks. Please write Bartlett Carry Club, RFD 3, Tupper Lake, NY

Resorts

IDAHO WILDERNESS. Small family homestead on beautiful Selway River. No roads. Access by horseback along historic Nez Perce Trail. Comfortable cabin accommodations, home-style meals, fishing, riding, hiking, rafting. Two weeks (minimum) - $690. Selway Lodge, Box 1100-H, Hamilton, MT 59840

NEW MEXICO. Guided tours—wildflowers, birds, prehistoric dwellings. Bear Mountain Ranch, Silver City, NM 88061 (505) 538-2538

OLD FASHIONED, SECLUDED FARM on Cape Breton Island offers log cabins, excellent meals, peace to a few guests. $225/week. Write: J. Gardner, Orangedale, Nova Scotia



Weekend market in Bangkok, Thailand — Virginie Farrero

SKIFFLES VILLAS, Anquilla, West Indies, unspoiled island, pool, beautiful beaches, luxurious, (219) 533-0461, 614 East Purl Street, Goshen, IN 46526

VACATION/RELAXATION—Birdwatcher's delight—Peaceful, secluded nature lover's mountain retreat. Cave Creek Ranch, Portal, Arizona 85632

Tours/Trips

Discover The YUKON! A "Gentle Adventure"

An unforgettable wilderness sojourn guided by John Lammers, seasoned naturalist and long time Yukon dweller: designed for 3-6 discerning people.

River, Mountain, Float & Fly-In Trips.

Call for brochure (212) 682-0480(NYC) or write: Yukon Wilderness Unlimited, P.O.Box 4126, Whitehorse, Yukon, Canada.

GALAPAGOS AND INCA PERU

A natural wildlife tour The trip of a lifetime! Two departures for two weeks, August and December 1981. Cost $2698 US per person. For information and brochures contact Wings of the World, Inc. Travel, 653 Mt. Pleasant Road, Toronto, Canada (416) 482-1223.

ADVENTURES—Observe whales in Baja Lagoons and off Maui, Hawaii. Photograph Polar Bears & Beluga Whales in Canadian Arctic. Wildlife adventures to South America, Galapagos, Kenya, Tanzania, Zambia & Zaire. Expeditions to New Zealand, Australia and the Himalayas. 1981 trip preview available. Adventures International, 4421N Albert, Oakland, CA 94619

AFRICAN EXPERIENCE: East or West Africa, Groups or Individuals. Forum Travel, 2437 Durant, Berkeley, CA 94704

ALASKA TRAVEL ADVENTURES—Experience Alaska in guided intimate group trips. Backpacking, canoeing, kayaking, whitewater, wildlife photography, fishing, custom trips. Alaska-Hawaii Combinations. Free catalogue describes 50 different trips throughout Alaska for all ages and abilities. Contact Alaska Travel Adventures, 499 Hamilton, Suite 212-EE, Palo Alto, CA 94301. In California call collect (415) 329-9013, elsewhere toll free (800) 227-8480

AMAZONAS ADVENTURES, alone or combined with Peru, Ecuador, Galapagos. Forum Travel, 2437 Durant, Berkeley, CA 94704

CANOE ARCTIC. Fly-in canoe expeditions into the heart of North America's last great wilderness—the tundra and taiga of Canada's Northwest Territories. Discover the warm dry summers, spectacular scenery, and unparalleled wildlife concentrations of a land untouched by man. Photograph caribou herds, white wolves, muskox, moose, grizzlies, rich birdlife. Virgin fishing. Groups of 6 or 8 persons assembled and guided by Alex Hall, wildlife biologist and veteran arctic canoeing guide. All food and equipment provided. Can accommodate a limited number with no previous canoeing experience. Two-way radio. 12 days from $1210; 18 days from $1570. For brochure write: Canoe Arctic Inc., Box 130(C), Fort Smith, N.W.T., Canada XOE OPO

CANOE TRIPS IN WILDERNESS NOVA SCOTIA, July-September. Small groups with licensed guides. Excellent food. Write: Granville Nickerson, RR#4N, Annapolis Royal, Nova Scotia, Canada BOS 1AO

CANOE WILD MAINE—Learn woods skills and natural history while canoeing northern Maine. Individuals, families, and conservation organizations welcome. Special courses with colleges. North Woods Ways, Box 34, Salisbury Cove, ME 04672

CHINA—Art, Archaeology tour—eight cities—top accommodations. July 30 - 28 days. Experienced artist/educator leader. (914) 359-6206

GALAPAGOS/ECUADOR/PERU. Economic guided tours from $1459. 8 to 15 days Galapagos, all meals. Weekly departures. Options: Quito, Amazon, Cuzco/Machu Picchu. University credit available. Details: J.A. Colley, LAST, Inc., 43 Milestone Road, Randallstown, MD 21133 (301) 922-3116

GALAPAGOS EXPEDITION, July 11, 1981, 20 days, $1990 plus air. Blue Sky Adventures, Dept. NH3 Oak Ridge, NJ 07438

HIKE THE SWISS ALPS. Swissair flies you to special hiking tours, led by popular author/mountaineer Fred Jacobson. Zermatt, Saas-Fee, Lenk, Kandersteg, Pontresina. Beautiful and challenging trails. Delightful country inns. Superb cuisine. 9th summer! Write Fred Jacobson, Depth. NH3, Chappaqua Travel, 24 S. Greeley Avenue, Chappaqua, NY 10514

HIMALAYAN ADVENTURE TREKS—Rammel Expeditions, Box 183, Tetonia, Idaho 83452. Enthusiastic Rammel trekkers will describe our quality trips on request. Write for reference list and information.

HIMALAYAN TRAVEL, INC. Trekking expeditions in the Everest and Annapurna areas of Nepal. Exotic cultures/spectacular mountain scenery. Box 481-NH, Greenwich, CT 06830 Toll Free (800) 243-5330

INTERNATIONAL NATURE & TREKKING TOURS. Galapagos, Peru, Nepal, Ecuador, Alaska, Tanzania, Kenya, Patagonia, Falkland Islands, Costa Rica, Guatemala and more. Expert leaders. Very small groups. Write: Wilderness Travel (formerly South American Wilderness Adventures), 1760-NH Solano Avenue, Berkeley, CA 94707

LOW-IMPACT WILDERNESS SKILLS and natural sciences. 2-14 day backpacking courses for all ages in Maine, Yellowstone, and Canyonlands. No experience required. East/West Wilderness School, RFD 3, Hebron, ME 04238

MAGIC BOLIVIA: Spectacular nature, legendary cultures, unadulterated by mass tourism. Unhurried traveling, fantastic photography, reasonable prices. Combinable with Peru (Cuzco, Machu-Picchu, etc.). Forum Travel International, 2437 Durant, Berkeley, CA 94704 (415) 843-8294

MEXICAN & CENTRAL EXPEDITIONS by Wayne Hussing, 11120 Raphel Road, Upper Falls, MD 21156 (301) 592-7247—White Water Rafting—Volcanic Climbs—Backpacking—Jungle Exploration—Overland Drives. Oct-July

NATURALIST GUIDED FIELD SEMINARS and tours, West Texas and Mexico. Rafting, hiking, backpacking, bus. University or Continuing Education credit as appropriate. Write Education Department, Chihuahuan Desert Research Institute, Box 1334, Alpine, TX 79830

NATURE PHOTOGRAPHY field work and instruction: adventure vacations to remote areas throughout the West. Rafting, horsepacking and hiking with professional guide/instructors. Brochure: The Natural Image, P.O. Box 45, Winthrop, WA 98862

OAXACA, MEXICO. Unique historical/cultural tour. Festivals; pre-Hispanic art; Mixtec, Zapotec civilizations. Oaxaca Club (415) 388-3503

OPEN DOOR Alaskan Water Adventures. Kayaking, Rafting, Birding in Prince William Sound and Copper River Basin. Box 1185N, Cordova, AK 99574 (907) 424-7466

ORIENTAL ECLIPSE EXPRESS. China—Mongolia—Siberia. Hong Kong, Nanking, Sian, Peking, Ulan Bator, Lake Baikal, Irkutsk, and Bratsk. View 31 July 1981 Solar Eclipse. 21 days-$3595. Baylis-Todd Eclipse Tour, Claremont Hotel, Berkeley, CA 94705 (415) 849-4333

PERU: Andean Archaeological trek along Inca Trail to Machu Picchu. August - Two weeks. Small group. Budget - $985. Write: High Country Passage, Box 1100-NH, Hamilton, Montana 59840 (406) 363-2555

SAIL PRINCE WILLIAM SOUND: Guided flotilla cruises. Lessons available. Whale observation. Nature Study. College credit. Alaskan Wilderness Sailing Safaris, Box 701N, Whittier, Alaska 99693 (907) 277-0160

SCOTLAND, ORKNEY, SHETLAND AND ICELAND. Comprehensive program of nature trips. Write: Caledonian Wildlife at McGregor Travel, 33 Lewis Street, Greenwich, CT 06830, or toll-free: (800) 243-5330

SMOKY MOUNTAIN FIELD SCHOOL. Intensive 5-day and 2-day field workshops in the Great Smoky Mountains National Park. Includes Wild Mammals, Birds, Natural History, and many more. Co-sponsored by Smoky Mountains National Park and University of Tennessee Continuing Education Division, 2016 Lake Avenue, Knoxville, TN 37916 (615) 974-6688

SUMMER IN YELLOWSTONE. Join us in Yellowstone National Park for field seminars on wildlife, geology, plants, art, photography, history, etc. Accomodations at Park Service facility. Academic credit available. The Yellowstone Institute, P.O. Box 515, Yellowstone National Park, Wyoming 82190

TRAVELEARN, SUMMER 1981. Cultural-natural historical tours to Africa, Hawaii, China, and Greece led by specialists in the fields of study encompassed within each program. Office of International Studies, Kean College of NJ, Morris Avenue, Union, NJ 07083 —Phone (201) 527-2461

WASHINGTON WILDFLOWER SAFARIS to Cascades and Olympics with professional naturalist. Brad's Tours, 401 E. Mercer #31D, Seattle, WA 98102

WILDERNESS TRAILS IDAHO. Backpacking, Ski-touring, and Bicycle-touring. Come adventure and learn with us. Trips for all abilities, everything provided. We have thirteen years experience and guide only in Idaho. Write: P.O. Box 9252 M, Moscow, Idaho 83843 (208) 882-1955

WYOMING RANCH VACATION. The West's finest family ranch, famous for over eighty years. Spectacular scenery. Great food, fishing, riding, relaxing. Dr. Oakleigh Thorne, II, resident naturalist. Call collect or write Valley Ranch, Southfork N, Cody, Wyoming 82414 (307) 587-4661

RATES AND STYLE INFORMATION

$1.75 per word; 16 word ($28) minimum. *Display classified* is $150 per inch. All advertisements must be prepaid. Rates are not structured for agency or frequency discounts. All advertisements are accepted at NATURAL HISTORY's discretion. Send check/money order payable to NATURAL HISTORY to: The Market, NATURAL HISTORY Magazine. Central Park West at 79th St., New York, NY 10024. Please include your personal address and telephone number, issue preferred, and suggested heading. Deadline—8th of month, two months prior to cover date (the January issue closes Nov. 8). Camera-ready art is required for display ads. A tearsheet or copy of the page with your ad will be sent upon publication.

Box numbers, telephone numbers, and hyphenated words count as two words; abbreviations and zip codes as one word each. All states are shown in two-letter code followed by zip, then telephone (with area code), if desired. Occasionally, slight editing is required for clarity. Thank you!

A Near Miss

Almost a decade ago, a large meteoroid came within thirty-six miles of the earth. The same meteoroid is expected back in 1997, when if all goes well, it will come no closer

by Stephen P. Maran

A brilliant object, apparently trailing smoke, streaked northward across the sunny sky in August 1972, shattering the lazy summer afternoon from Utah north to Alberta, Canada. In some places, startled observers also heard sonic booms and called the police to report an aircraft in distress. Among the observers, however, were several amateur astronomers and, by rare luck, a vacationing expert on meteor physics. These spectators immediately realized that they were witnessing one of the rarest of meteoric phenomena—a daylight fireball.

Only later, when many firsthand accounts were compared, did the expert, Luigi G. Jacchia of the Center for Astrophysics in Cambridge, Massachusetts, realize that he had seen an event unique in recorded history: the earth had been "buzzed" by a large meteoroid that neither crashed to the ground nor broke up in the atmosphere, but actually escaped back into space. Recent calculations show that the August 10, 1972, meteoroid is coming back and that it will pass the earth again in 1997, with only a slight chance of hitting our planet the second time around.

Meteoroids are chunks of rock and iron that move through space in orbits around the sun. If they reach the earth's surface, they are termed meteorites. The flash of light produced as a meteoroid streaks through the lower atmosphere is known as a me-

teor, and an exceptionally brilliant meteor, corresponding to a large meteoroid, is called a fireball. These terms are loosely used; a scientist will often write "meteor" or "meteorite" when "meteoroid" is actually meant.

The event in August 1972 was unquestionably a fireball, since even in broad daylight it was a spectacular sight. It also qualified as a bolide, or a fireball accompanied by sonic booms.

When a meteoroid encounters the lower layers of the earth's atmosphere, it is slowed by air resistance, while friction heats it, melting away some surface material. In the process, most meteoroids are reduced to dust or to small fragments. Among the uncounted millions of meteoroids out in space, there must be many that have grazed the uppermost layers of the atmosphere and then continued on their journeys. Nothing is known of such encounters, however, since they are not detectable from the ground.

Meteoroids are just small asteroids, and indeed the practical distinction is that asteroids can be viewed through telescopes, while meteoroids are too small to be seen except when they flash through the lower atmosphere. As a result, astronomers keep track of a few thousand asteroids, but have no specific knowledge of any of the immense number of meteoroids that exist in the solar system. (The streams of comet dust that produce "meteor

Celestron®



For the photographer, astronomer, naturalist, educator, or casual observer — Celestron has established a new standard in superb telescopes and telephoto lenses at affordable prices (from $295). All feature large observatory mirror/lens type optics folded into a compact, lightweight, portable telescope or telephoto lens. Close-up detail borders on the fabulous from celestial objects light years away, to ships, planes, flowers, wildlife or people. Here is truly an instrument that allows you to observe or photograph the world around you. Celestron also has a full line of binoculars of astronomical quality.



Send $2.00 for 32-page full color catalog on how to select and use a Celestron telescope or telephoto lens.

Celestron International
2835 Columbia St., Box 3578-NH
Torrance, Calif. 90503, U.S.A.
Telephone: (213) 328-9560

(Dealer Inquiries invited.)



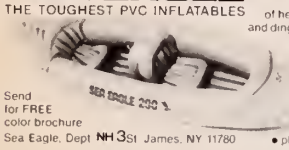
University of California, Santa Cruz

JOIN A WILDLANDS RESEARCH TEAM IN THE MOUNTAIN WEST OR CANADA

- Wildlife Research
- Wildlands Research
- Wild River Research

SUMMER, 1981
Field Courses, 5 Units
Phone (408) 429-2822 or write:
WILDLANDS RESEARCH INSTITUTE
Cardiff House
University of California Santa Cruz
Santa Cruz, CA 95064

SEA EAGLE
THE TOUGHEST PVC INFLATABLES



A new series of heavyweight canoes and dinghies $100 – $220
All pack small
All last years

Send for FREE color brochure
Sea Eagle, Dept NH 3St James, NY 11780 • phone 516-724-8900

TICKLE THE IVORIES!
PATENTED SYSTEM!



FASTEST, EASIEST PIANO COURSE IN HISTORY
FREE INFORMATION CORRELATION MUSIC,
BOX 751-A, LA CANADA, CA 91011

BOOKS PUBLISHED

National book publisher can print your book for as little as 18c per copy (paperback, 100,000 copies). For further info write: Regal Press Inc., 4501 N.E. 36th Street, Oklahoma City, Oklahoma 73121 or call (405) 424-3362.

WHEN YOU WRITE TO NATURAL HISTORY

about a subscription renewal, billing, or any kind of adjustment, please include your present address label.

Moving? Please notify 6 weeks in advance. Send your present address label along with your new address to Natural History Membership Services, Box 4300, Bergenfield, NJ 07621.

Name _____

New Address _____

_____

City _____ State _____ ZIP _____
Please Print Attach Label

showers" on schedule every year are a wholly different phenomenon.) The single exception is the August 10, 1972, meteoroid, the only one whose future whereabouts can be calculated.

The reports of sonic booms are what suggested to Jacchia that the meteoroid had continued on into space. Near the middle of the observed flight path, Montana viewers heard the sonic boom, although those who saw the fireball farther to the north over Canada heard nothing. If the meteoroid had continued to fall to lower altitudes, it would have "lowered the boom," producing louder sounds than those heard in Montana. But a sonic boom generated at heights above thirty-seven miles will reflect upward from the atmosphere below the generating source, thereby preventing any sound from being detected at ground level. For this reason, Jacchia concluded that the meteoroid must have been lower than thirty-seven miles while over Montana, but higher than that over Alberta, where it must have been on the way up, not down. This interpretation was confirmed when precise measurements of the meteoroid's altitude became available from an unexpected source, making it possible to determine the orbit of the space visitor.

The unexpected source of fireball-tracking data was an artificial satellite orbiting the earth, which actually viewed the fireball from above. Details of the satellite findings were disclosed in 1974 by a group of physicists from the Aerospace Corporation and the Aerojet ElectroSystems Corporation, two military-contractor organizations in southern California. According to their report in the February 15, 1974, issue of the periodical *Nature*, infrared radiation was recorded by the satellite when "the meteor first became sufficiently hot to be detected over Utah," and the measurements continued for about 100 seconds until the fireball "finally cooled below the detection threshold," 930 miles to the north. During this time, the meteoroid traveled along a shallow, curved trajectory at speeds in excess of 31,000 miles per hour. By the physicists' reckoning, it carried an energy of "approximately the yield of the nuclear weapons [that] destroyed Hiroshima and Nagasaki." Analysis of the satellite measurements also showed that the low point in the meteoroid's flight was 35.9 miles above the ground in east-central Idaho, a few miles south of the Montana border, confirming Jacchia's deduction.

The meteoroid energy referred to above is not the chemical or nuclear energy of a bomb but rather what is called the kinetic energy of a rapidly moving, massive object. When this kinetic energy is released by the object on impact, however, it can have an explosive effect. The best illustration of this phenomenon is Meteor Crater (which should, of course, be called Meteorite Crater), a ¾-mile-wide scar in the northern Arizona plateau. Meteor Crater is at least 30,000 years old, and most of the large impact craters on the earth are even older, indicating that major meteoroid impacts are now very rare.

There has been much controversy over the size and mass of the August 1972 meteoroid. One estimate is that it was a stone of about a million tons, with a diameter of 260 feet. At the other extreme is a calculation suggesting that the object may actually have been smaller than the stone meteorite that fell harmlessly in pieces near Jiling (Kirin) in the People's Republic of China in March 1976. The largest fragment of the Jiling meteorite weighs 3,900 pounds.

The disagreement over the August 1972 meteoroid has several roots: misprints in tracking data, which may have affected some scientists' calculations; differences in computing methods; and uncertainties about the brightness of the fireball and the composition of the meteoroid. *Nature* gave the results of the satellite measurements, in terms of the speed and altitude of the meteoroid, for only three locations along the fireball path, but it turns out that the longitude of one location and the latitude of two were listed incorrectly.

The methods that various researchers used to compute the meteoroid's mass involved deductions from its infrared radiation, from its apparent brightness, and from the rate at which the flying object was decelerated by air resistance. The conclusions reached about the mass and the size of the meteoroid, regardless of the computation methods, depend on whether the meteoroid was made of stone, of iron with a high nickel content, or of a combination of stone and iron. These substances have very different densities. The actual density of the August 1972 meteoroid will affect the results of the computations made by any method, but no one

A Taste of India
with
Nepal-Sri Lanka-Bhutan
Burma-Thailand

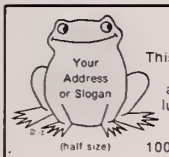
Journeyworld offers you the architectural splendours and unforgettable sights of some of the world's most creative civilisations.

You will see the Taj Mahal, Kathmandu in the Himalayas, the stupendous rock carved temples of Ajanta & Ellora, Bhutan a fairy tale Buddhist kingdom, colorful Kandy in Sri Lanka, the glory of Pagan and Mandalay, the elephant camps and tribal villages of Chieng Mai.

The programs include comprehensive sightseeing, deluxe hotels and all meals.

For brochures write to:

JOURNEYWORLD INT'L LTD.
155 EAST 55th STREET
NEW YORK, N.Y 10022
TEL: (212) 752-8308



(half size)

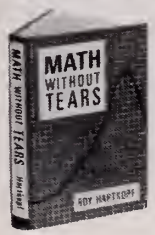
FROG Stickers

This Happy Green Frog, printed with your name and address or slogan, adds a little fun to letters, books, luggage, toys, promotions. . . .

Frog Shape. . .Self-Stick
100 for $6.50 or 200 for $9.20 ppd.

FROGS, Box 735-T, Acton, Mass. 01720

MATH WITHOUT TEARS



Using non-technical language and a light touch Roy Hartkopf gives you a basic understanding of many everyday applications of mathematics. He takes the reader from simple counting to trigonometry and calculus, emphasizing the practical aspects of math. Humorously written.

Learn math in the comfort of your own home at minimum cost.

Order Now:$9.95plus 95¢ hdlg.
EMERSON BOOKS, INC.
Dept. 558-F Buchanan, N.Y. 10511
10 Day Money Back Guarantee

Natural History Nice'n Neat



Slip your **Natural History** issues into permanent files for ready reference. Green leather-like face embossed in gold to look like fine books. It holds one year's subscription. Also for **Smithsonian**, blue, 1 year. **Audubon**, green, 1 year. **Scientific American**, red 1 year. **National Wildlife**, blue, holds 3 years. Specify title and quantity. Postpaid.

$5.20 ea. **$4.63** ea., 3 or more.

Send check or Master Charge or VISA number with exp. date, signature to

Highsmith
Box 25 NAT Ft. Atkinson WI 53538
Catalog of files free with order

knows the composition of that meteoroid.

The problem posed by deriving the meteoroid's dimensions from satellite measurements of the intensity of infrared radiation was the lack of precedent. Since the technique has never been applied before, no one knows how reliable it is. Deductions made from the brightness of visible light, on the other hand, are based on the "luminous efficiency" method, which, although it has often been applied, is nevertheless suspect. In this method, the mass of the meteoroid is computed from a relation between meteoroid mass and observed meteor brightness. In some cases, this relationship has been determined by studying the brightness of artificial meteoroids fired from rockets. The parameters that relate brightness and mass depend on what a meteoroid is made of, and they have been determined from rather small meteoroids. We do not know whether the derived relationships can be extrapolated to objects as large as the 1972 meteoroid.

Another difficulty is that although the August 1972 fireball was seen by thousands of people, its visible-light brightness is not accurately known. There was nothing suitable in the sky to use as a standard of comparison. Witnesses agreed that the fireball was much brighter than a full moon but far dimmer than the sun. This still leaves considerable margin for error.

The technique of estimating meteoroid mass from the rate at which air resistance slows a flying object is sensitive to the composition of the meteoroid, but as mentioned above, the composition of the August 1972 meteoroid is simply not known. Most astronomers have assumed—or guessed—that this meteoroid was a stone, since the great majority of meteoroids are thought to be stones. Laboratory measurements of meteorites, however, show that even the stone ones vary widely in density. Uncertainty over the actual density will affect the mass deduced from an observed deceleration since if two objects of the same mass travel the same path at the same speed, the less dense object, being larger, will suffer more resistance by the air. Another, less serious problem is that the mass of the August 1972 meteoroid was not constant from one observation to the next. As shown by the eyewitness reports of smoke behind the fireball, it was losing mass along its trajectory. The smoke, a phe-



For centuries man feared it, made sacrifices to it, wailed over it. Now we run to greet it. You are extended a unique invitation to witness one of nature's most awesome spectacles, a total eclipse of the sun. On July 31, 1981 the British cruise ship, m.s. Coral Princess will be positioned 1000 miles off the coast of Japan to rendezvous with eclipse totality.

The ORIENT ECLIPSE CRUISE and expedition is the sequel to the six previous historic VOYAGE TO DARKNESS eclipse expeditions which successfully intercepted totality off the coasts of Nova Scotia, Africa, the Caribbean, in the Pacific and at Montana's Big Sky eclipse expedition.

The ORIENT ECLIPSE CRUISE adventure offers a distinguished staff of shipboard lecturers (including meteorologist Dr. Edward M. Brooks) scientific, cultural and educational programs, and tours of Japan, Hong Kong, Macau and China.

Join us as we probe earth, sea and space for yet another exciting and memorable cosmic adventure as we sail into totality and beyond.



ORIENT ECLIPSE CRUISE

Voyage to Darkness VII

NH

Orient Eclipse Cruises, Inc.
1080 Fifth Avenue
New York, N.Y. 10028

Please send me more information on the ORIENT ECLIPSE CRUISE

Name _____

Address _____

City _____

State _____ Zip _____

Mid-Winter Savings Now In Effect!



At last—an efficient woodstove beautiful enough for your home

The WESO Ceramic Tile Stove enhances the beauty of the most tastefully decorated home, where a black metal heater would be rudely out of place.

You can see the flames flickering behind the wrought-iron style grille as the WESO — which employs both convection and radiant heat — surrounds you with gentle all-over warmth.

The WESO burns both wood and coal, holds a fire all night without tending, and offers every efficiency feature you could ask for. Now available in your choice of seven decorator tile colors.

Enclosed is $1. Rush me your literature showing the WESO CERAMIC TILE STOVE in all 7 tile colors — plus details about WESO's new COALBURNING STOVE — and shipping schedule for winter delivery.

Name _____

Address _____

_____ Zip _____

Ceramic Radiant Heat
2913 Pleasant Drive, Lockmere, N.H. 03252

BOOK HUNTING?

Virtually any book located—no matter how old or long out-of-print. Fiction, nonfiction. All authors, subjects. Name the book—we'll find it! (Title alone is sufficient.) Inquire, please. Write: Dept. 71

BOOKS-ON-FILE P.O. BOX 195
UNION CITY, NEW JERSEY 07087

international nature tours

Galapagos Islands/ Headwaters of the Amazon/Ecuador/ Peru/Patagonia/ Falkland Is./Kenya Tanzania/Rwanda Gorilla Safari/Costa Rica/Nepal/New Guinea

Expert Naturalist Guides
Very Small Groups



Write: WILDERNESS TRAVEL*
1760-NJ Solano Ave., Berkeley, CA 94707
(415) 524-5111
*formerly So. American Wilderness Adventures

nomenon that astronomers call a meteor train, consisted of material shed as the meteoroid was heated by friction with the air. In addition, the mathematics of the deceleration method were established for typical meteoroids, which fall along fairly steep paths, rather than for an object such as the August 1972 meteoroid, with a grazing trajectory like that of a stone thrown to skip off water.

In view of the foregoing, it is hardly surprising that published estimates of the mass of the August 1972 meteoroid have ranged all the way from two tons to one million tons. Recently, however, a new analysis has given us what is probably the most reliable available information.

The new study is by Zdenek Ceplecha, an authority on meteor observations at the Astronomical Institute of the Czechoslovakian Academy of Sciences. He analyzed the full list of satellite measurements, which has never been published, and developed an improved deceleration method that allows for both the grazing trajectory and the frictional shedding of matter by the August 1972 meteoroid. By internal cross-checking, Ceplecha determined that the errors that affected the original list of measurements in *Nature* had been eliminated. There is still no way to get around the unknown density of the meteoroid, even by means of the improved deceleration method, but it seems likely that the meteoroid is a stone of 100 to 1,000 tons, with a diameter of twelve to thirty feet.

The most interesting aspect of Ceplecha's work, for me, is his calculation of the future orbit of the August 1972 meteoroid. The object no longer follows its original path, having been disturbed by its 1972 encounter with the earth. Instead, it now revolves around the sun approximately once every 21½ months, following an elongated elliptical orbit that brings it out into the asteroid belt, far beyond Mars, and then back toward the sun, reaching almost six million miles inside the earth's orbit. The orbits of the meteoroid and the earth cross at one point in space, but thankfully both objects do not usually pass this place at the same time. They won't even come close until August 1997, when the meteoroid will have completed fourteen orbital revolutions since it zoomed past Idaho at an altitude of less than thirty-six miles in 1972.

In 1997, the meteoroid is expected

Joseph L. Sax

Mountains Without Handrails

Reflections on the National Parks

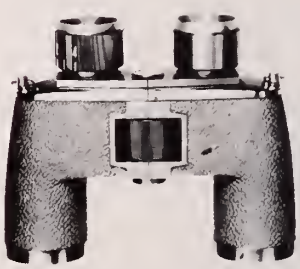


Sax proposes a novel scheme for the protection and management of America's national parks, giving perspective to the longstanding and bitter battles over use of our national parklands: hikers vs. cyclists; ski resort developers vs. wilderness advocates; "industrial tourism" vs. recreational "elitism."

$10.00/*paper* $5.95

The University of Michigan Press
Dept. OM P.O. Box 1104
Ann Arbor, MI 48106





BUSHNELL 7x35 CUSTOM
Mfg. List $280.00 Postpaid $164.00

This is an example of the deep discount prices on high quality optics that is found in our FREE catalog. This catalog lists and illustrates an outstanding selection of telescopes, binoculars etc., plus valuable information on how to properly select them. Write for it today.

GIL HEBARD OPTICS
COURTHOUSE SQ., KNOXVILLE, ILL. 61448

to zip by the orbital intersection point four days before the earth gets there, so all should be well. The only hang-up is that, according to Ceplecha's calculations, this conclusion has an eight-day uncertainty factor. Thus, the meteoroid may pass the intersection point as much as twelve days before or four days after the earth gets there. This means that a slight but real possibility exists that both orbiting bodies will reach the intersection at the same time. Should that happen, no one would choose to be close to the place on the earth where the meteoroid would hit, but there is no way to judge where that place might be. Perhaps by 1997 we will have the technology to detect a large incoming meteoroid before it strikes the earth's atmosphere and to determine the danger zone. In the meantime, lacking any such ability, let's hope that we have no worse natural disaster to fear between now and the likely miss in 1997.

Stephen P. Maran is a senior staff scientist at NASA's Goddard Space Flight Center in Greenbelt, Maryland. The views expressed here are his own and do not necessarily represent those of NASA.

WHEN YOU WRITE TO NATURAL HISTORY

about a change of address, renewal of subscription, billing, or any kind of adjustment, send the present address label from the magazine wrapper.

Moving? Please notify 6 weeks in advance. You can use this form to tell us about a move or order a subscription.

Change of address—Attach your address label in the dotted area and fill in your new address below, clip and mail to Natural History Membership Services, P.O. Box 4300, Bergenfield, N.J. 07621.

Cut your old address label from magazine wrapper and attach over this area.
Fill in your NEW address and mail to:
Natural History Magazine
Membership Services P.O. Box 4300
Bergenfield, N.J. 07621

PLEASE PRINT

Name _____

New Address _____

City _____ State _____ Zip _____

Picasso

Imagine the beauty and excitement of these sculptures in your home...



Shown much smaller than actual size—Each 12" High.

"L'HOMME ET LA FEMME" BY PICASSO
22 KARAT GOLD LEAF/EDITION LIMIT: 750

Picasso's towering genius blazed a trail of glory across the arts of the twentieth century. His immortal works of art are a joy and delight to own and to live with.

Now, Collectors' Guild, Ltd.—one of America's oldest, largest and most distinguished societies of collectors of original works of art—is privileged to present an extraordinary limited edition of Picasso sculpture: "L'Homme et la Femme."

Each is hand-leafed in 22 karat gold over foundry stone® by APF Studios, who have served such leading museums as The Metropolitan Museum of Art and the Smithsonian.

The 22 karat gold leaf is meticulously applied by skilled craftsmen by hand to achieve a brilliant, flawless gold surface. Mounted on polished marble, the sculptures are works of dazzling beauty and perfection...to enjoy now and to pass on with pride to future generations.

These superb works of art are available exclusively from Collectors' Guild in a serially numbered edition permanently limited to 750. A Certificate of Authenticity will accompany your sculptures.

Orders will be filled in strict sequence of receipt so it is important to act promptly.

RESERVATION FORM

"L'HOMME ET LA FEMME" BY PICASSO
Collectors' Guild, Ltd.
601 West 26th Street, New York, N.Y. 10001

Please send me "L'Homme et la Femme" by Picasso.

☐ Enclosed is a check/money order for my down payment of $180. I understand that I will be billed for the balance, after shipment, in four consecutive monthly installments of $180, totalling $900.

Please charge the $180 down payment:
☐ MasterCard ☐ VISA
☐ American Express ☐ Diners

NHM-381

Card # _____

Expires _____

Signature _____

Name _____

Address _____

City, State, Zip _____

Phone Orders: Call collect (212) 741-0400 attention Judy Douglas

Celestial Events

by Thomas D. Nicholson

The Moon The waning crescent moon will be in the east to greet early risers on the first few days of March. The moon will then disappear as it passes between the earth and sun and becomes new on the 6th. The evening crescent should show up in the western sky at dusk on about the 9th, waxing to first-quarter on the 12th. From then until full moon on the 20th, expect bright moonlight during early evening hours and throughout all or most of the night. Last-quarter is on March 28, the next new moon on April 4, and first-quarter on April 11. Perigee moon (nearest the earth) is on March 8 and April 5; apogee (farthest from the earth) on March 24.

Stars and Planets We haven't seen bright planets in the evening sky since summer, but now, at long last, Jupiter and Saturn are back in and Virgo is to the right of its bright star, Spica. They are quite close to one another, rising in the east after dark and high in the south about midnight. Jupiter is easily the brighter of the two, the brightest starlike object you will see at night this month. Saturn, a little to its left and above it, is less than one-fifth Jupiter's brightness, about as bright as Spica. Both planets are shifting west through the stars, as you can see by watching them drift slowly away from Spica. But they will remain close to one another through this coming summer. Jupiter and Saturn are also prominent in the morning sky, where they set in the west at about dawn. All the planets are morning stars until late in March except Mars, which becomes one in early April, when Jupiter and Saturn are technically evening stars. None of the other planets are located where they can be seen.

The sun, in March, moves easterly through the stars of Aquarius until the 13th; it then enters Pisces. Mercury moves from Capricornus to Aquarius, Venus from Aquarius to Pisces, and Mars from Aquarius also to Pisces, but with a brief skip through a corner of Cetus. Jupiter, Saturn, and Pluto are in Virgo, Uranus in Libra, and Neptune in Ophiucus.

March 1: Mercury is stationary among the stars and resumes its direct (easterly) motion as a morning star.

March 11–12: The bright star near the moon tonight is Aldebaran, in Taurus. The moon passes very close above Aldebaran at about 12:00 A.M., EST, on the 12th, so close that it covers the star (an occultation) over northern Canada and Alaska.

March 15: Mercury is at its greatest westerly elongation (greatest distance to the right of the sun). That would ordinarily be an excellent position for a morning star. But this is not a good elongation; the planet rises too late and too slowly to be seen in the morning twilight.

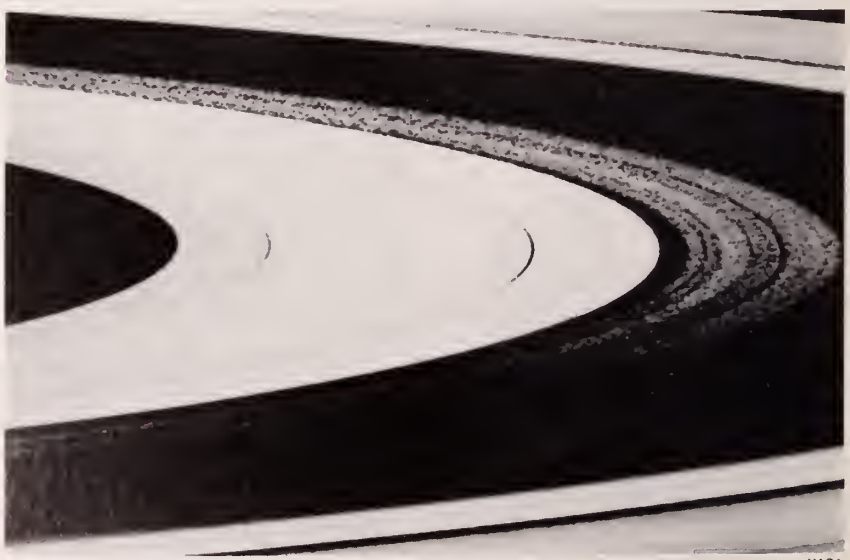
March 20: The sun arrives at the vernal equinox at 12:03 P.M., EST, and spring begins in the Northern Hemisphere (autumn south of the Equator). Although today is the official date of the "equinox" (meaning night and day are of equal length), the length of the day (the interval from sunrise to sunset) has been more than twelve hours since the 17th. The full moon is near Jupiter and Saturn tonight. Watch it drift slowly above the two planets, passing closest to Jupiter at about 8:00 P.M., EST, and to Saturn about three hours later.

March 26: Jupiter and Saturn are at opposition, located opposite the sun in our sky. They now move into the evening sky, rising before sunset, setting before sunrise.

April 2: Mars is in conjunction with the sun, ending its long sojourn as an evening star. Although it now becomes a morning object, it will not be worth looking for until next December.

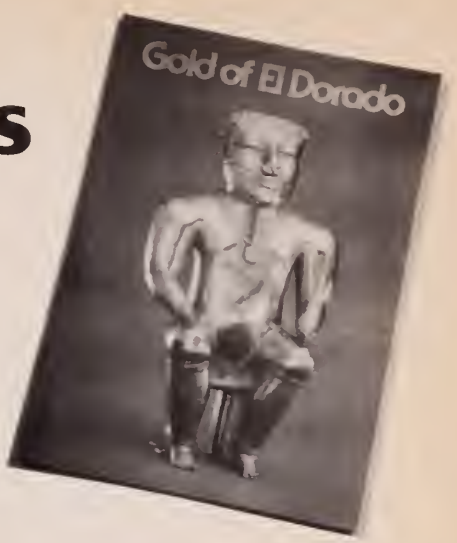
April 4–5: New moon is on the 4th, perigee about twenty-four hours later. The effect of perigee will enhance the usually strong spring tides. Expect exceptionally high tides the night of April 5.

April 7: Venus is in superior conjunction, in line with the sun and earth but beyond the sun. The planet now leaves the morning sky and becomes an evening star, but not a very prominent one until June.



The rings of Saturn NASA

An Art Book That Took Centuries To Create



It took the American Museum of Natural History four years to arrange its exceptional exhibition of more than 500 pieces of ancient gold from Colombia. But those few years are a brief time when compared with the decades archeologists have spent digging (literally!) and studying the gold artifacts from tombs, caves, and buried sites. And all that time is short when compared with the many centuries prehistoric Indians practiced their craftsmanship and artistry to create these treasures.

So when it became the United States sponsor for this outstanding collection, the American Museum faced a dilemma. Could we do justice to all this effort and scholarship and beauty? We think we have. First, by dramatically displaying *Gold of El Dorado: The Heritage of Colombia* in one of our largest halls. The glowing reports from visitors tell us our efforts have been worthwhile. If you don't have a chance to see the show for yourself in New York, we hope you will see it in Chicago, San Francisco, or New Orleans on its year and a half tour.

The second challenge for the American Museum was the creation of an appropriate book to accompany the exhibition. We decided against a traditional catalog; against a small, boring volume with tiny black-and-white pictures that could never do justice to these fine objects. Instead, we decided to present a select number of the finest pieces of pre-Columbian gold in a large, stunning format. And to represent the three important elements that make a great art book we chose outstanding professionals.

First, photographer Lee Boltin. One of the greatest photographers of art objects, he also took the famous pictures of the Tutankhamun show. We sent him abroad to find and record great pieces of pre-Columbian art.

Second, archeologist Warwick Bray, from the University of London. One of the world's foremost authorities on pre-Columbian art, Bray is also a skilled writer, able to present fascinating background in a succinct, readable essay in the book. Dr. Bray organized the Colombian gold exhibition in London.

Third, Harry N. Abrams, Inc., America's leading publisher of fine art books. In a co-publishing venture with the American Museum, Abrams designed the book, supervised the preparation of 30 large color plates, and monitored the fine-quality printing.

The result is an unprecedented exhibition book. It is bold and big—each plate is 16 by 11½ inches—bigger than this magazine *opened up*. The paper is heavier than most posters. In fact, many persons have purchased two copies of the book in order to have one set of these fine art prints for framing.

And now for the happy ending. Because the Museum is a co-publisher, we are able to offer this soft-bound art book at a major savings from its normal retail price of $12.50. We are pleased to offer *Gold of El Dorado* to subscribers for only $6.25—a 50% savings off its regular price. This special offer is valid only during the exhibition and only while our limited supply lasts. We suggest that you order one or more copies immediately. Of course, if you are not satisfied after you have had an opportunity to examine it in your home, simply return the book and the Museum will refund the purchase price.

Natural History Books

Gold of El Dorado Book
American Museum of Natural History
77 West 77th Street
New York, N.Y. 10024

YES, I want to purchase _____ copy/copies of the Gold of El Dorado book. I ☐ enclose payment of/☐ authorize you to charge me $6.25 per copy (plus $1.00 for shipping and handling).

My name _____

My address _____

City _____ State _____ Zip _____

For charge orders only:

Charge to: ☐ Master Charge ☐ VISA ☐ American Express ☐ Diners Club

Interbank # (Master Charge Only) _____

Account # (All digits) _____

Expiration Date _____

Signature _____
(required if using credit card)

Order

_____ book(s) @ $6.25 $____

Shipping and handling $1.00

N.Y. Sales Tax (if applicable) ____

TOTAL $____

(Make checks payable to American Museum of Natural History)



The 1981 NATURAL HISTORY Photographic Competition Deadline is April 1

The Grand Prize-winner this year will have a rare opportunity to photograph exotic wildlife with a close-up lens. And the winner may not even be a photographer. Let us explain about the special 1981 contest:

The Grand Prize will be an eleven-day trip, including airfare from New York and a berth on the yacht *Buccaneer,* to the Galápagos Islands. Many fearless creatures on those islands let photographers walk right up to them. The tour, sponsored by the American Museum of Natural History, will be led by two Museum scientists.

Seventeen cash prizes, totaling $3,500, will go to winners in seven categories, including a special new one, Historical Photographs. In this category, you need not be the original photographer, but you do have to own the picture and it should be more than fifty years old. So search your attic and old albums for prize-winning pictures that fit our three major categories.

The three major categories are Animals (including birds and bugs); Plants and Their Environment, and The Human Family. First prizes of $500 will be awarded in each.

In addition, Merit Awards of $250 each will go to the best entries in four categories: Photomicrography; A Sequence in Nature (up to five photographs); Historical Photographs; and Humor in



Nature. Ten Honorable Mentions of $100 each will be selected from all entries.

The winning entries will be published in the July issue of *Natural History* and exhibited at the American Museum of Natural History.

THE RULES

1. The competition is open to everyone except employees of the American Museum and their kin.
2. Competitors may submit up to five previously unpublished entries (a sequence is considered a single entry).
3. The Museum acquires the right to publish, exhibit, and use for promotion the winning photographs. The Museum assumes no responsibility for entries.
4. Entries may be transparencies or prints, either color or black and white, up to 8 by 10 inches. Each must bear the photographer's name and address. Entries must *not* be mounted in glass.
5. Enclose a self-addressed, stamped envelop for the return of entries.
6. Entries must be postmarked no later than April 1, 1981.

Pack them carefully and mail them to:

Natural History Photographic
Competition
11 West 77th Street
New York, New York 10024

And good luck!

Nelson's Glass Eye and Other Tricks of the Trade

There is an old story told in the American Museum of Natural History about a former curator of prehistoric archeology, Nels C. Nelson, who had a glass eye. Nelson was a scientist on the Central Asiatic expedition, led by Roy Chapman Andrews, that explored the Gobi Desert in the 1920s. Mongolia, which had recently undergone a revolution, was a wild and lawless area at the time, ruled by warrior princes and crisscrossed by nomadic bands. At one point in 1925, the expedition ran into a hostile and well-armed group of Mongols on horseback, with the usual cartridge belts slung across their chests. The warriors had dismounted and were parlaying with the nervous expedition leaders when Nelson had an idea. Pretending to be a magician, he removed his glass eye, held it up for all to see, then slipped it back into its socket. The Mongols fled.

Whether the story is true or not, it illustrates an important point: Museum scientists and expeditions have had some close calls in the field, especially in countries at war.

The Jesup North Pacific Expedition (1897–1903) gave the Museum its first real taste of trouble. Organized by Morris K. Jesup, the Museum's third president, the expedition set out to explore the cultures of the entire North Pacific rim, from Washington State to Manchuria in northern China. One expedition leader, Russian anthropologist Waldemar Jochelson, was dogged and harassed by the czar's secret police while working among the aborigines of Siberia. Another anthropologist, Berthold Laufer, found himself in the midst of the Boxer Rebellion, the unsuccessful uprising against foreigners in China. In another incident, he was prevented from studying the Ainu of southern Sakhalin Island, Siberia, by a "band of desperadoes." Later, while in Manchuria, he survived the Russo-Japanese war.

The artifacts these explorers brought back, many of which are on display in the Museum's new Hall of Asian Peoples, are priceless from an anthropological point of view. The various household, religious, and ceremonial items, sleds, clothes, art, and other objects were collected just before many of the fragile circumpacific cultures were destroyed or westernized. In many cases these items provide the only record of now vanished peoples.

The greatest difficulties in the field were encountered by the ambitious series of expeditions conceived, organized, and directed by Roy Chapman Andrews between 1915 and 1930. Although Andrews's primary goal of finding the birthplace of the human race in Central Asia was never realized, his Central Asiatic Expeditions made spectacular and important discoveries of fossils (including the first dinosaur eggs) and brought back extensive collections of archeological artifacts, ethnographic material, mammals, birds, plants, and minerals—in short, just about anything worth collecting. But there were difficulties.

During this period China was embroiled in a series of civil wars, and Mongolia was in a state of near anarchy. Nonetheless, Andrews led his caravan of camels and motorcars across thousands of miles of Central Asia, across borders, through mountain passes, and over the vast wasteland of the Gobi Desert. He armed his expedition with hunting rifles and a machine gun and packed a revolver and cartridge belt himself. He was extremely impatient with minor officials, red tape, and roadblocks. In his reports to the Museum's president, Andrews wrote that he prevented "unwarranted delays" at border crossings by telling the obstructive official that he was quite prepared to shoot his way through. This "good trick," he reported, "usually worked."

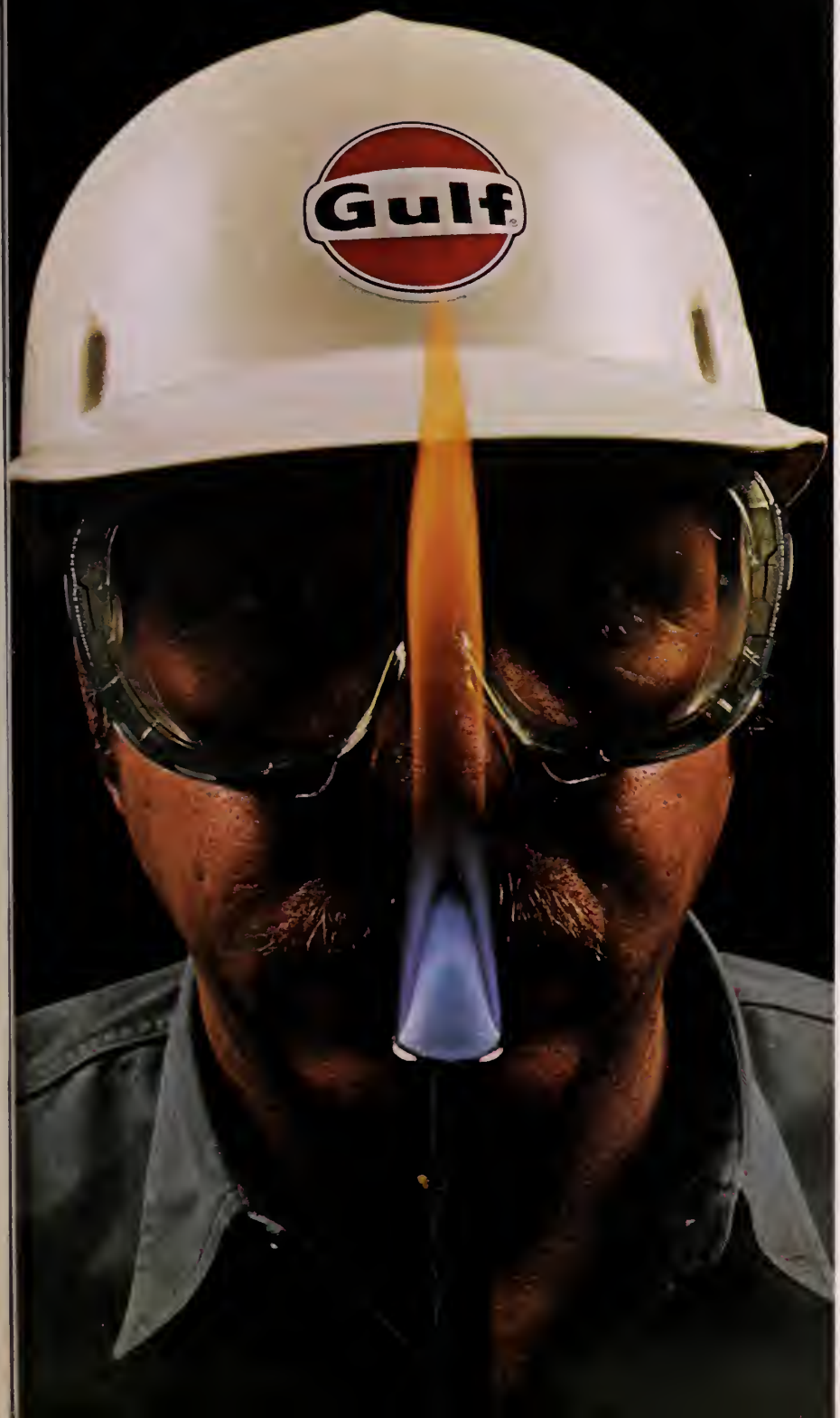
Andrews's chauvinism was typical



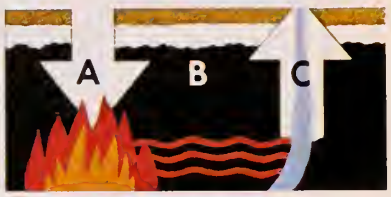
AMNH

Roy Chapman Andrews, at camp in Dah Ser Hai in the Gobi Desert, is visited by a Mongolian delegation. Andrews, who was recuperating from a gunshot wound at the time, was leader of the Museum's Central Asiatic Expeditions.

"How we get energy out of coal without taking the coal out of the ground."



"A lot of coal in America—millions of tons, in fact—is too deep or too slanted to be mined by any conventional techniques," says Gulf Engineer Jerry Daniel. "At Gulf, we're working with the Department



Air through injection well supports combustion of coal at A, fire heats coal at B, which produces gas recovered through production well, C.

of Energy on a way to extract the energy from that coal without mining it. We drill an injection well to set fire to the coal. By burning some of the coal, we heat up the rest, which causes it to produce gas. That's why it's called underground coal gasification.

"We had a test burn here in Rawlins, Wyoming, late in 1979, and we're setting up another one. Our hope is that by 1990, industry will be able to use this kind of synthetic gas, which of course will make us less dependent on expensive imported crude oil as an energy source.

"At Gulf, our first priority is to get all the oil and natural gas we can out of resources right here in America. But we're working on a lot of other good ideas, too. Underground coal gasification is one of them; and we're working with synthetic fuels, tar sands, geothermal energy, and other alternative energy sources.

"Overall, you might say that the business we're really in is the business of energy for tomorrow."

Gulf

Gulf people: energy for tomorrow.

Gulf Oil Corporation

"Someday we may use gas from coal the way we now use natural gas."

Amazon

Cruising Expedition across a Continent



With naturalist guide/lectures, enjoy the excitement of seeking wildlife on daily boat excursions into the waterways of lush jungle from the headwaters at Iquitos to the delta at Belem, then to Rio. Fine accommodation/ cuisine on our MS WORLD DISCOVERER — the world's most sophisticated expedition cruise ship. October departures, 21 days, from $3900. Write for details.

Society Expeditions Cruises Inc.
723 Broadway E
Seattle, WA
98102 USA

Name NH-3

Street

City/State/Zip

Cruising expeditions also to: ☐ Amazon ☐ Antarctica ☐ New Guinea ☐ Indonesia ☐ Seychelles ☐ Red Sea ☐ Iceland/Greenland

M.S World Discoverer Registered in Singapore

NATURAL HISTORY MAGAZINE BINDER

The functional way to save your full year's issues for future reference and pleasure. "Natural History" stamped in gold color on dark green leatherette over heavy binder's board 12¾" x 9" Price $6.50. Members $5.85



American Museum of Natural History
Museum Shop
Dept 229
C PW at 79th St
N Y N Y, 10024

Qty	Price	Shipping Handling	Total
		$2.00 ea.	
		Order Total	
		N Y Sales Tax	
		Total Amount	

Enclosed is check/money order for $ _____

Name

Address

City State Zip

of his generation. Dedicated to his work, to the Museum, and to science, he believed that extreme measures to further scientific goals were necessary for the good of humanity. The concepts of tact, compromise, and diplomacy were foreign to his philosophy, but if it were not for his aggressiveness, invaluable research and priceless collections would have been lost.

Andrews cheerfully risked his life, taking excessive risks for the benefit of the expedition. On one occasion, when he had been holed up in Peking for some time and was impatient to pick up supplies at Tientsin on the coast, he attempted to drive his car from Peking to Tientsin across the front lines of two armies battling for the imperial capital. The following account of Andrews's trip is taken from one of his reports:

"On April 13 there was heavy gunfire just outside of Peking, and after a dinner at the American Minister's, we adjourned to the roof of the Peking Hotel. The machine guns showed in a steady stream of light along the southern horizon punctuated by the wide flashes of heavy guns.

"I wanted to get through to Tientsin and made a try for it the next day with three members of the Expedition—Shackelford, Hill, and Beckwith. We thought that a large American flag on the car would protect us as it had done in former years. The gates of Peking were heavily guarded, but the soldiers let us pass. Carts were already coming into the city loaded with grain, camp gear and soldiers. Cavalry streamed by and then thousands upon thousands of infantry. An officer told me that Chang Tso-lin's troops had taken Tungchow, fourteen miles from Peking, and were looting

Hopi Spirit

The Hopi have the distinction of being America's oldest, continuously surviving culture. The pueblo of Oraibi in Arizona, for example, has been in existence since pre-Columbian times. The Hopi survived the expansion of the United States into the West and the turbulent Indian Wars by dealing with, and learning from, European culture, while retaining their basic values and traditions.

Hopi Kachina: Spirit of Life, a traveling exhibition designed and organized by the California Academy of Sciences, is now on display in Gallery 3, marking the first time the Hopi have cooperated fully with a museum project. The core of the exhibition is 150 kachina figurines donated by Nathaniel Owings; these are carved by the Hopi to represent spirits known as kachinas. According to tradition, the kachinas come down every year from the San Francisco Peaks in Arizona to the dry mesas below, where they participate in the seasonal cycle of dances. Included in the exhibition are models of Hopi villages and kachina ceremonies (where the figures are used to represent human dancers), original murals, music, artifacts, and slide presentations, giving the visitor the sense of being in a Hopi village in northern Arizona during the ceremonies. The exhibition will close May 8.

Hopi Films

On Saturday and Sunday, March 7 and 8, from 2:00 to 4:00 P.M., several archival and one recent documentary on the Hopi will be shown in the Auditorium. Elizabeth Weatherford, director of the film project at the Museum of the American Indian, will introduce the films, among which are *The Snake Dance at Walpi* (1901), one of the first films ever made, and *Hopi* (1981), demonstrating the strength of the Hopi "traditionalist" way of life. The programs are free.

Hopi Symbols

A new exhibit, *Bird, Cloud, and Snake: Hopi Symbols,* will open March 10 in the Akeley Gallery. The rich fertility symbolism of Hopi art is revealed through tapestries, woodcarvings, pottery, paintings, and more. Visitors are advised to visit *Bird, Cloud, and Snake* before seeing the major exhibition in Gallery 3, *Hopi Kachina: Spirit of Life.*

The Rise of Icarus

A new exhibition, *Gossamer Albatross: The Challenge,* opens in the Roosevelt Rotunda on March 1. The *Gossamer Albatross*, piloted by Bryan Allen, was the first human-powered aircraft to cross the English Channel. Its designer, Paul MacCready, won the Kremer Prize of $200,000 for this feat. Two years earlier, Allen became the first person to achieve sustained human-powered flight when he flew a figure-eight course of more than a mile in the *Gossamer Condor.* On June 12, 1979, Allen pedaled the seventy-pound *Albatross* across the Channel in just under three hours at an average speed of eleven miles per hour. The centerpiece of the exhibit is the *Gossamer Albatross* itself. A short film depicting the historic crossing will be shown continuously. The exhibit is sponsored by Du Pont, which provided MacCready

the city but that no fighting was taking place.

"We drove on slowly, and eventually passed beyond the rear of the retreating army. For three or four miles the countryside was deserted, houses closed and all as quiet as the grave. We were five or six hundred yards from the ancient marble bridge at Tungchow when there came the sharp crack of a rifle and a bullet struck beside the front wheel. A second later a mass of soldiers appeared on the road and bullets began spattering around us like hailstones. They had opened fire with a machine gun, but it was aimed too low and the bullets were kicking up the dust just in front of us. The soldiers could see the American flag plainly enough but that made not the slightest difference.

"Fortunately at this particular spot the road was wide enough for the car to be turned and I swung it about in record time. The bullets now were buzzing like a swarm of bees just above our heads. Forty yards down the road a sharp curve took us out of sight of the machine gun. The other men crouched in the bottom of the car. Since I was driving I could see all the fun. It was a pretty rough road, but the speedometer showed fifty miles an hour as we went back. The ride became an exciting one. All the houses which had seemed so peaceful actually were occupied by the advance-guards of Fengtien soldiers. They had let us pass because of the American flag, but when they heard the firing in our rear and saw us returning at such a mad speed, they evidently thought that we were anybody's game. Each and every one decided to take a shot at us.

"For three miles we ran the gantlet

with the ultralight covering for the aircraft.

The Bene Israel

The March membership program will be *Shanwar Telis: Shipwrecked Jews of India*. The story of a small group of Jews who were shipwrecked on the west coast of India 2,000 years ago and eventually settled near Bombay is told in Johanna Spector's award-winning film *The Shanwar Telis or Bene Israel*. The program, which will describe the group's history, customs, and ceremonies up to the present day, is presented in cooperation with the American Jewish Congress and will take place on Wednesday, March 18, at 7:30 P.M. in the Auditorium; nonmembers must pay an admission fee of $3.50.

Drama 1A

A new sky show, *The Drama of the Universe*, opens at the Hayden Planetarium on March 5. In a series of short "acts," the show presents intriguing facts and discoveries and looks at recent astronomical theories. Call (212) 873–8828 for sky show times.

Toddler Tales

A program for youngsters will be presented in the Education Hall on Saturday, March 21, at 11:00 A.M. and 2:00 P.M., and on Sunday, March 22, at 1:00 and 3:30 P.M. A short play, *Tale of Two Whales*, using puppets, slides, and a film of the birth of a Beluga whale, will start the program. Children will then have the chance to color pictures and handle objects such as a narwhal tusk. The program is designed to introduce 3- to 7-year-olds to the natural sciences. Advance registration is necessary; call the Membership Office at (212) 873–1327 for more information.

Martial Arts

Capoeira is a martial art brought from Africa to Brazil, where it has been practiced for 300 years. A combination of dance, song, and ceremony that requires acrobatic skills, capoeira is performed with a great deal of somersaulting and kicking. The African-American program of the Education Department is presenting a free lecture-demonstration with Bill Moore on the art of capoeira on Sunday, March 15, at 2:00 P.M. in the Auditorium.

What Is It?

March 7 is the Museum's annual *Identification Day*. Staff members from the Museum's scientific departments will be on hand to identify and explain any and all objects you bring in, whether they be fossils, minerals, bones, feathers, baskets, cockroaches, shells, beetles, pottery, arrowheads, or beads. This free program takes place in the Education Hall from 1:30 to 4:30 P.M.

Hindu Myth

The Education Department will offer a lecture by Wendy Doniger O'Flaherty on *How to Prove That a Mythical Experience is Real*. O'Flaherty, a professor of Indian studies at the University of Chicago, will discuss the interpretation of dreams and visions using Hindu texts. The free lecture will be given on Sunday, March 22, at 2:00 P.M. in the Auditorium.

Long live the tiger!

SAVING THE TIGER

Guy Mountfort, founder of The World Wildlife Fund
Foreword by Sir Peter Scott, Chairman of The World Wildlife Fund

Beautiful and ferocious, the tiger has fascinated man for centuries, but until recently little was known of its private life. Here is the complete story—illustrated with over 100 breathtaking photos, many never before published—of the life of the wild tiger and the remarkable international campaign to save the species from extinction.



THE VIKING PRESS, Dept. ATE-NH
625 Madison Ave., New York 10022
Please send me _____ copies of SAVING THE TIGER @ $16.95. Add sales tax where applicable plus $1.50 per copy for shipping. I enclose $_____ total.

Name _____

Address _____

City _____ State _____ Zip _____

Share the Thrills of Exploring Outer Space!



$279.95 f.o.b. Hartford, Conn.

$15 Crating Charge

Now it's easy to join the thousands of serious amateurs who have discovered the excitement of exploring our mysterious universe. Your enjoyment begins right from the start, yet the challenges and rewards go on for years! And it's a hobby that can be shared at modest cost.

Choose From Many DYNASCOPES®

Picking a telescope to fit your needs and your pocketbook is simple when you select a DYNASCOPE—the same instruments used by more than 150 schools, colleges and observatories—and your satisfaction is guaranteed by a full-refund warranty.

FASCINATING GUIDE YOURS FREE!

Read these valuable facts before buying any telescope. Mail coupon or postcard for your complimentary copy of this helpful guide.



Criterion Manufacturing Co.
620 Oakwood Ave. W. Hartford, Conn. 06110

® TM Registered U.S. Pat. Office

CRITERION MANUFACTURING CO., Dept. NH-101
620 Oakwood Avenue, W. Hartford, Conn. 06110
Please send your free Telescope Guide.

Name _____

Address _____

City _____ State _____

of firing from both sides of the road. I would see a soldier standing ready with his rifle at the side waiting until we came opposite. Then 'bang' he would let us have it. Sometimes they fired in squads; sometimes singly. The only reason why we were not riddled with bullets is because the Chinese soldier is the world's worst shot. Most of them aimed directly at the car, when they aimed at all, and the bullets struck just behind us. Every now and then one would zip in close to my head but no one was hit. I really had the best of it because the others could not see what was going on and driving the car kept me busy. I expected every moment that one of the tires would be hit. A blowout at that speed would have turned us over.

"Before long we could see the rearguard of the retreating army and the sniping at us ceased. Still our troubles were far from being ended. The first retreating soldiers, three of them, asked for a ride. I thought that they might be a protection and let them stand on the running board of the car. Suddenly one of them saw an officer. Without a word he stepped backward off the car, rolled on the ground with his right hand under the rear wheel. As I put on the brakes it ground his hand and arm into the hard gravel road. I have never seen such a sight; his hand was simply shredded. I put on a tourniquet to stop the bleeding but he was only anxious for us to go.

"A little farther and we came to masses of infantry. Against my protests they piled on the car in such numbers that it could pull only in first speed. The inevitable happened when one fell off, breaking his leg. Things looked pretty bad. Three or four of the soldiers worked themselves into a rage, cocked their rifles and were just about to shoot us when an officer appeared. Fortunately he could speak Mandarin Chinese perfectly (the others talked a difficult Shantung dialect) and when I explained what had happened he cleared a passage so that we could drive off the road into the fields. With much difficulty we got through the gates back to Peking."

The Chinese later seized part of the expedition's collections, and Andrews was made to understand that his collecting days in Central Asia were over.

Today Museum curators and research associates continue to experience politically inspired problems in the field, especially in countries with unstable revolutionary governments and those led by military juntas. Most scientists, naturally enough, are reluctant to discuss their experiences for fear the publicity will further compromise their research efforts; their stories will have to wait for a later day.

Even without political problems, fieldwork has never been easy. But its rewards are great; the Museum's collections would be poorer if scientists had not been willing to take risks. And even more important, our knowledge of cultures that have now vanished would be sketchy indeed.

Douglas J. Preston

A Museum expedition to Siberia led by Waldemar Jochelson in 1900 faced a variety of problems. Jochelson (standing, center) and his wife (seated) were the first whites to cross the Stanovoi Mountains. With winter coming and their horses exhausted, Jochelson built a raft and floated the party to safety.



AMNH

Fill out this coupon and save the children

Complete this simple questionnaire, and befriend a needy child through Save the Children. For only fifty-two cents a day, your money, combined with that of other sponsors, can breathe new life into an impoverished village... help hardworking people in their fight for dignity... turn despair into hope for a child who has known only disaster. Fifty-two cents may not buy much where you live. But for the poorest of the poor where the need is so desperate, it can work miracles. NH 3/1

My Name Is _____
(please print)

Address _____

City _____ State _____ Zip _____

Tell us how you want to help, by answering these questions:

1. What kind of child would you like to help?

☐ Boy ☐ Girl ☐ No preference

2. What geographical area are you interested in?

Urgent need exists in all the areas listed below, especially overseas. If you have a strong preference for a particular location, check the area of your choice. If not, won't you please let us assign a child where the need is greatest?

☐ **Certainly. Choose a child for me in an area of greatest need.**

I strongly prefer:

☐ Africa	☐ Honduras	☐ Mexico
☐ American Indian	☐ Indonesia	☐ Nepal
☐ Bangladesh	☐ Inner Cities (U.S.)	☐ Southern States (U.S.)
☐ Chicano (U.S.)	☐ Israel	☐ Sri Lanka (Ceylon)
☐ Colombia	☐ Lebanon	
☐ Dominican Republic	☐ Mediterranean	

3. Would you like a picture of your sponsored child?

Shortly after we select a child for you, we can send you a photograph and brief personal history, if you desire.

☐ Yes ☐ No

4. Would you like to exchange correspondence?

If desired, correspondence can build a meaningful one-to-one relationship and provide a unique educational experience for the sponsored child. In areas where illiteracy is high, a village representative will keep you informed of the progress your child is making. Translations, where necessary, are supplied by Save the Children.

☐ Yes ☐ No

5. Would you like information about the child's community?

Several times a year you can receive detailed reports on the activities and projects being undertaken in the community to benefit your sponsored child. These community reports show how your money is being used most effectively for permanent improvements to the child's environment—for health care, education, food production, nutrition, and community training. Would you like to receive such information?

☐ Yes ☐ No

6. How do you wish to send your sponsorship contribution?

Enclosed is my check for $_____ .

☐ Monthly, $16 ☐ Semi-annually, $96

☐ Quarterly, $48 ☐ Annually, $192

7. Do you wish verification of Save the Children credentials?

Save the Children is indeed proud of the handling of its funds. Based on last year's audit, an exceptionally large percentage (83.5%) of each dollar spent was used for program services and direct aid to children and their communities. Due to volunteered labor and materials, your donation provides your sponsored child with benefits worth many times your total gift. Would you like to receive an informative Annual Report (including a summary financial statement)?

☐ Yes ☐ No

(A complete audit statement is available upon request.)

8. Would you rather make a contribution than become a sponsor of an individual child at this time?

☐ Yes, enclosed is my contribution of $_____.

☐ Check here for general information about our unique programs for aiding impoverished children.



© 1981 SAVE THE CHILDREN FEDERATION INC

Mail to:

David L. Guyer, President

Save the Children.

50 Wilton Road, Westport, Connecticut 06880

YOUR SPONSORSHIP PAYMENTS AND CONTRIBUTIONS ARE U.S. INCOME TAX DEDUCTIBLE

Established 1932. The original U.S. child sponsorship agency. Member of the American Council of Voluntary Agencies for Foreign Service.

photo Bentley Kassal

Padua's Botanical Garden (p. 50)

Lavishly illustrated, E.S. Hyam and W. MacQuitty's *Great Botanical Gardens of the World* (New York: Macmillan, 1969) includes an excellent chapter on the Padua botanical garden with a detailed account of its history and a description of the garden as it is today. J. von Sachs's classic *History of Botany (1530–1860)* (New York: Russell and Russell, 1967), translated by H.E.F. Garnsey and revised by I.B. Balfour, was first published in 1890. It has three major parts: History of Morphology and Classification 1530–1860; History of Vegetable Anatomy 1671–1860; and History of Vegetable Physiology. A continuation of Sachs's *History* first published in 1909, J.R. Green's *A History of Botany (1860–1900)* (New York: Russell and Russell, 1967) surveys plant morphology, anatomy, and physiology in the late nineteenth century. C. Thacker's *The History of Gardens* (Berkeley: University of California Press, 1979) is an in-depth account of the history of gardens from ancient times to the present. Lively and well written, it includes a chapter on the Renaissance garden in Italy and a description of the evolution of the modern botanical garden.

Siberian Cranes (p. 58)

A source of information on crane conservation and captive breeding projects is the International Crane Foundation's quarterly newsletter published for its members, *The Brolga Bugle*. The last three issues (January 1981, October 1980, August 1980), all available for $1.00 apiece from the foundation, at Baraboo, Wisconsin 53913, feature articles on Siberian cranes. D. Alexander's "Report from a Troubled Land" (*International Wildlife*, June 1980, pp. 45–48), a short survey of the status of wildlife in Afghanistan, tells of the headway conservationists there were making with Siberian cranes before the Soviet takeover and what has happened since. L.H. Walkinshaw's *Cranes of the World* (New York: Winchester Press, 1973), the standard text on cranes, is available in most libraries. For a general text on management techniques used for endangered birds, see S.A. Temple's *Endangered Birds* (Madison: University of Wisconsin, 1978).

Gossamer Odyssey (p. 64)

The most thorough work on the flight of the *Gossamer Condor* is M. Grosser's *Gossamer Odyssey*, scheduled to be published in May (New York: Houghton Mifflin, 1981), from which the article in this issue is adapted. Beginning with da Vinci's flying machine and ending with the *Gossamer Condor*'s success at the 1977 Kremer Competition, D. Dwiggins's *Man-powered Aircraft* (Blue Ridge Summit: Tab Books, 1979) surveys the history of human-controlled flight. A more detailed, comprehensive treatment of the subject, D. Reay's *The History of Man-powered Flight* (Oxford: Pergammon Press, 1977) includes a chapter on the Kremer Competition. Large and colorful, S. Dalton's *The Micracle of Flight* (New York: McGraw-Hill Book Co., 1977), a step-by-step investigation of how winged objects, both animal and mechanical, fly, devotes its last two chapters to the evolution of human-powered flight. M. Hewish's "How *Gossamer Condor* Was Pedalled Through the Sky to Win £50,000" (*New Scientist*, October 6, 1977, pp. 28–29) explores the aircraft's successful design, and M.E. Long's "The Flight of the *Gossamer Condor*" (*National Geographic*, January 1978, pp. 130–40) features many color photographs of the aircraft. "Winged Victory of the *Gossamer Albatross*" (*National Geographic*, November 1979, pp. 640–51) is pilot B. Allen's account of his historic flight across the English Channel.

Vermont (p. 72)

H.F. Wilson's *The Hill Country of Northern New England* (New York: AMS Press, 1967), reprinted from the 1936 edition, is a social and economic history covering the transformations in farm life in the White and Green mountains. C.W. Johnson's *The Nature of Vermont* (Hanover: The University Press of New England, 1980) is a readable history and natural history of Vermont. N. Perrin's *Vermont in All Weathers*, with photographs by S. Bullaty and A. Lomeo (New York: The Viking Press, 1973), is a personal, chatty chronicle of what Vermont life is like each month of the year; his collection of essays on country life, *First Person Rural* (New York: Penguin Books, 1980), includes chapters on fence posts, making maple syrup, and buying a pick-up truck. *Contrary Country* (Brattleboro: The Stephen Greene Press, 1961) celebrates what author R.N. Hill calls Vermont's "private flavor" and Vermonters' "trait of waywardness." *Mrs. Appleyard's Farm Kitchen*, by L.A. Kent and P.K. Campion (Boston: Houghton Mifflin Co., 1977), is a cookbook whose recipes of traditional Vermont country cooking are sometimes preceded by anecdotes of Vermont life. Folklorist J. Beck's *The General Store in Vermont* (Montpelier: The Vermont Historical Society, 1980) is a collection of anecdotes derived from her tape-recorded interviews with store owners. This paperback is available for $4.50

from the Vermont Historical Society, 109 State Street, Montpelier, Vermont 05602. This society also publishes *Vermont History*, a scholarly quarterly, and *Vermont History News*, an informal newsletter, for its members. A subscription to *Vermont Life* is available for $6.00 from *Vermont Life*, 61 Elm Street, Montpelier, Vermont 05602. Also available from them are *Vermont for Every Season* (Montpelier: *Vermont Life* Magazine, 1980), a collection of essays on specific times in Vermont, such as peak season (during the height of the fall foliage) and mud season; and *Justice in the Mountains* (Shelburne: New England Press, 1980), D. Davis's account of his career as a Vermont country lawyer, judge, and, finally, governor of the state.

Dead-Tree Insects (p. 84)

Intended as a basic exposition of ecology for the beginner, R.E. Ricklef's textbook *The Economy of Nature* (Portland: Chiron Press, 1976) includes chapters on community diversity and energy flow. Ricklef's earlier book, *Ecology* (Portland: Chiron Press, 1973), an 881-page study, is broader and more comprehensive. Part 8, "Community Ecology" (pp. 589–780) interprets the patterns that occur at the community level in terms of ecological and evolutionary processes at the population level. More specific references on insect–deadwood ecology are H.E. Savely's "Ecological Relations of Certain Animals in Dead Pine and Oak Logs" (*Ecological Monographs*, July 1939, pp. 322–85), and S.A. Graham's "The Felled Tree Trunk as an Ecological Unit" (*Ecology*, October 1925, pp. 397–411). These well-written, still relevant articles are easy to follow and available in most libraries.

Rita Campon



If you'd like a poster of these two gentlemen for your bar, drop us a line

JACK DANIEL AND HIS NEPHEW, Lem Motlow, disagreed on most everything. Until it came to making whiskey.

Mr. Jack (that's him on the left) was a fancy dresser. So Lem refused to wear a tie! But they both insisted on mellowing their whiskey through huge vats of charcoal before aging. And we're about the only distillery who still does it that way today. You see, Mr. Jack once said, "Every day we make it, we'll make it the best we can." And neither Lem nor anybody else ever disagreed with that.



CHARCOAL MELLOWED DROP BY DROP

Tennessee Whiskey • 90 Proof • Distilled and Bottled by Jack Daniel Distillery
Lem Motlow, Prop., Inc., Route 1, Lynchburg (Pop. 361), Tennessee 37352
Placed in the National Register of Historic Places by the United States Government





Blueberry Blues

Although it tastes better, the lowbush berry is more difficult to harvest and more expensive to produce

by Raymond Sokolov

photographs by Adelaide de Menil

Passing through Washington County, Maine, in August, even the least-informed traveler knows that he is in the right place for cheap, fresh lobster and that he cannot go any farther east in the United States than this bleak, coastal pocket of poverty. The alert visitor also notices that many apparently abandoned fields are littered with string. That's how it looks at first. Then it becomes clear that the string has been purposely arranged, stretched in a pattern of roughly parallel lines. Sometimes, people are hunched down along those lines of string. Watch long enough and the people move, slowly making their way down the string rows, and then heading back to the road, to blue machines set up on the shoulder. The machines are for winnowing, and the people are picking blueberries, but the neophyte wonders, "Where are the blueberry bushes?"

Those accustomed to highbush blueberry shrubs (*Vaccinium corymbosum*), which grow as tall as six to eight feet, have to look twice before they make out Maine lowbush plants (*V. angustifolium*), flourishing at ankle level, camouflaged by grasses, alder shoots, and sweet fern. The berries themselves are tiny, roughly half the size of the cultivated highbush fruits sold in supermarkets. Lowbush berries are almost never sold as whole, fresh fruits outside New England and they are not cultivated in the normal sense of the word, that is, planted by man from a selected stock. Lowbush berries are wild, naturally occurring, not adapted to mechanical harvesting, difficult to ship or store fresh, and generally impractical. But they are superb berries, tastier by far than the comparatively insipid highbush cultivars grown commercially in Michigan and other states with more hospitable climates.

Highbush plants and the even taller rabbiteye blueberries (*V. ashei*) grown in the Southeast have two crucial advantages over the undeniably more delicious lowbush fruits. Because of selection and hybridization begun by U.S. Department of Agriculture botanist Frederick V. Coville in 1909, the cultivated berries are very large and therefore appealing to consumers, who tend to taste with their eyes. Furthermore, highbush plants are high. Machines can harvest them easily and, perhaps more important, each plant can be picked selectively several times, so that only perfectly ripe berries are taken during each pass. This means that markets get an ideally uniform crop. Lowbush shrubs, on the other hand, can only be harvested once because the hand rake takes all the berries as it combs through the brush. Pickers have to wait until all the berries in a given patch have ripened. By the time this happens, the early-ripening berries on each plant are turning senescent, getting soft. Rough handling from the rake and the winnowing machine, which separates the berries from the leaves and stems pulled in by the rake, further degrades the appearance of the berries and diminishes their keeping quality.

These factors have seriously reduced the lowbush berry's appeal as a marketable fresh fruit. Also, the big Maine blueberry companies, located



at the edge of vast, flat stretches of blueberry patches known as the Barrens, have had little incentive to bother with shipping the lowbush berries fresh, for they have traditionally been able to sell almost the entire crop to large baking companies for use in muffins as well as muffin and pancake mixes. Even the mass market consumer prefers the little lowbush berry in his muffins. Unlike the bigger highbush berries, which turn into large blue blots when baked, lowbush berries don't look messy after baking, and the manufacturer can put more of them in each muffin—an advertising plus.

Recently, however, even the baking industry has been forced to look with increasing favor on the highbush berry. Lower production costs make the bigger berries roughly thirty cents a pound cheaper. Moreover, besides yielding berries that are easier to harvest and clean, highbush blueberry bushes are far more efficient producers than the wild Maine species. In Michigan, growers have been able to pick an average of two to three tons of berries per acre every year. In Maine, the average yield is only 800 to 1,000 pounds per acre every other year, and most of those acres have to be as laboriously tended as if they were conventional cultivated fields.

"I don't know what they mean when they talk about Maine wild blueberries," says Mary Ellen Bailey, an independent blueberry producer based in Columbia Falls, Maine. "We fertilize. We mow out weeds. We run oil burners over the fields."

Indeed, the only thing "wild" about Maine blueberry production is that the plant propagates itself, spreading its rhizomes underground and producing its own seed. Growers encourage the process with a battery of land-management techniques designed to reduce competition from other plants and from pests, as well as to improve the vigor of the blueberry plants themselves.

Native blueberry fields are really forests artificially held back at the low-shrub state of old-field succession by weed control. After the harvest, growers burn over their fields, a process that eliminates all surface growth but that leaves the blueberry rhizomes unharmed below ground. In effect, moreover, the burning prunes the blueberries and spurs their growth.

Meanwhile, birds spread new seed over the cleared fields, and established rhizomes take over more territory. By July, new growth begins to show above ground. Buds appear but do not blossom in the first year. Because of this biennial cycle, growers rotate their harvests so that only half their fields are in the nonfruiting stage at one time. Yearling shrubs turn red in the fall. Then growers hope for a good snow cover, which will shelter the plants from freezing winter weather. Finally, in the spring of the second year, they have the pleasure of seeing their blueberries blossom. Each bud puts forth several white or pink-tinged blossoms in late May or early June.

At this point, growers have to contend with various pests and diseases, the worst of which is the blueberry maggot. Its larvae attack the berries and feed on their flesh. To eradicate the larvae, many growers spray infested fields at the end of June.

By the end of July, the lowbush blueberry crop has ripened. Day after day, local people—schoolteachers, students, whole families—collect in the fields early in the morning, stooping over the bushes with the short-handled rakes that resemble cranberry scoops. Made from galvanized metal,







To harvest the delicious lowbush blueberry, pickers must spend long hours stooped over the rows of ankle-high plants. A rake of galvanized metal, top right, is used to pull the berries off the bushes.

these tools have long, thin teeth and a reversed handle that extends over the teeth, so that when the picker tilts a rake, berries roll into a collecting area at the back. One Abijah Tabbutt of Columbia Falls invented the blueberry rake in 1883. The first one, designed for the rough ground of unimproved fields, had only eight teeth. On today's flatter fields, on the Barrens, pickers use rakes with forty to sixty teeth. Tabbutt's grandson Clarence Drisko carries on the business at 86, selling most of the 3,000 rakes he produces in a year to the giant blueberry companies, Jasper Wyman of Millbridge and A.L. Stewart and Sons of Cherryfield.

Both companies bus in Micmac Indians from Nova Scotia for the harvest, but many of the pickers are Washington County residents earning extra cash for back-to-school clothes or for plain subsistence in the bleak economy of rural Maine. On the Barrens, where picking conditions are ideal, a large family can make up to $400 a day. But the work is very hard and a complete anachronism in the general context of American agriculture. The largest machine at a picking site is the winnower, which is a portable conveyor belt device usually run by a lawn mower motor. Some are still operated by hand.

"Every year for fifteen years, I've stood on the Barrens and said to myself, 'I don't believe that people will pick 20 million pounds of blueberries like that,' " says Amr Ismail. Dr. Ismail, an expatriate Egyptian, is no casual observer of the lowbush blueberry scene. He is the Maine Blueberry Professor of Horticulture at the University of Maine in Orono. Ismail also supervises the Blueberry Hill Environmental Farm, a research facility in Washington County. There, in scientifically managed, mulched plots, this exuberant, rotund botanist and a small team of colleagues are developing lowbush blueberry clones that will produce a bigger crop of berries than the average wild types. More important, these clones are lowbush cultivars. At Blueberry Hill, there is now actually a cultivated patch Ismail has developed. The clone spreads slowly, taking a decade to cover a field. But Ismail says that

"this may be the future. Perhaps we will compromise and go to existing fields to put desirable clones in open places left by herbicides." He also anticipates that, as the cost of hand picking rises, "they'll invent a picking machine." In fact, the University of Maine has already developed a rake head suitable for machine harvesting on level fields that are weed free.

In general, Amr Ismail is an optimist. He sees a bright commercial future for lowbush blueberries although he concedes that "once we get to propagating and planting, we won't be dealing with the native, natural plant any more." Ismail, of course, has faith in his clones. But Tom Rush, general manager of A.L. Stewart and Sons, thinks hard times are ahead for the lowbush blueberry. He told the *Wall Street Journal* that by 1985 half of all Maine growers will be forced out of the blueberry business by low prices. Ismail and Rush may actually be talking about a similar future, since only well-capitalized blueberry operations will be able to survive in a market dominated by Ismail's cultivated clones.

The ordinary consumer should be concerned about the future of *Vaccinium angustifolium*, but there is really no legitimate position for most of us to take, except to hope that the cultivated lowbush berries of the future will continue to taste as good as the experimental varieties I sampled at Blueberry Hill. For the time being, the only sensible thing is to cross your fingers and make the trip to Washington County in August to taste the quintessential American berry in the only place you are sure to find it fresh.

Once you are in Maine, you can even arrange to pick your own berries. For me, this foraging, which is almost always technically a trespass on somebody's land, is one of the most exhilarating things to do in the outdoors. Robert Frost caught the beauty and mild mischief of it in his horticulturally precise poem, "Blueberries":

> You ought to have seen how it
> looked in the rain,
> The fruit mixed with water in
> layers of leaves,
> Like two kinds of jewels, a
> vision for thieves.

Raymond Sokolov, a writer with an interest in the history and preparation of food, is editor of Book Digest.



Blueberry Muffins
(Adapted from a recipe submitted to *All Maine Cooking*
[edited by Ruth Wiggin and Loana Shibles, Courier of Maine Books]
by the late Margaret Chase Smith, senator from Maine)

- 1½ cups fresh blueberries
- 1½ cups flour
- ½ teaspoon salt
- 3 tablespoons sugar
- 1 tablespoon baking powder
- 1 egg, lightly beaten
- ¾ cup milk
- 3 tablespoons melted shortening

1. Preheat oven to 400 degrees.
2. Wash the blueberries and drain thoroughly.
3. Sift together the flour, salt, sugar, and baking powder.
4. Stir the beaten egg and milk together and then stir into the flour mixture. Add berries and melted shortening.
5. Mix well and pour into a greased muffin tin, filling each compartment three-quarters full.
6. Bake for 20 minutes.

Yield: 9 to 12 muffins

Beth and Millie Gardner's Baked Blueberry Pudding
(Adapted from *Cutler Cookery*,
United Methodist Church, Cutler, Maine)

- ½ cup plus 1 tablespoon shortening
- Salt
- ½ cup brown sugar
- 2 cups blueberries
- ½ cup white sugar
- 1 egg, lightly beaten
- ¼ cup milk
- 1 cup flour
- 1 teaspoon baking powder
- Whipped cream

1. Preheat oven to 350 degrees.
2. In a saucepan, combine 1 tablespoon shortening, a pinch of salt, and the brown sugar. Cook over medium heat until the sugar melts. Then stir in the blueberries and pour mixture into a greased baking dish.
3. Beat together the remaining ½ cup of shortening with the ½ cup white sugar until smooth. Then beat in egg and milk.
4. Sift together flour, baking powder, and ¼ teaspoon salt. Mix with mixture from step 3 to make a batter.
5. Cover blueberry mixture with the batter and bake for ½ hour. Serve with whipped cream.

Yield: 8 portions



JETTA. 4 IN THE FRONT. 8 IN THE BACK.

Compare the relative merits of today's family cars, and you'll find that a trip to your relatives would be a lot nicer in a Volkswagen Jetta.

In the front, for example, there's room enough for a family of 4 to actually stretch out and enjoy the ride.

In back, there's a trunk big enough to handle 8 suitcases. (Something you don't even get with a Rolls-Royce.)

And under the hood, there's a CIS fuel-injected engine powerful enough to take you from 0 to 50 in just 9.2 seconds. As well as around any trucks, onto any highways and up any mountains you meet along the way.

What's more, even though Road & Track has said it "will embarrass a lot of cars costing a lot more" with its performance and handling, Jetta will never embarrass you at the gas pump.

It gets an EPA estimated 25 mpg, 40 mpg highway estimate. (Use "estimated mpg" for comparisons. Your mileage may vary with weather, speed and trip length. Actual highway mileage will probably be less.)

And it gives you front-wheel drive, rack-and-pinion steering, all-independent suspension and classic European styling.

Impressed with Jetta's relative merits?

Your relatives will be, too.

VOLKSWAGEN DOES IT AGAIN

© 1980 VOLKSWAGEN OF AMERICA


A
LEGEND
COMES TO
LIGHT.
★ ★ ★ ★ ★
Now you can
illuminate your
own home with
the same famous
crystal that
lights up such
legendary places
as Kennedy Center
and Westminster
Abbey.
★ ★ ★ ★ ★
Crystal lamps
and chandeliers.
Shining lights
that have
no peers.
★ ★ ★ ★ ★
Be sure it's
authentic Waterford.
Blown by mouth,
and cut wholly
by hand.
In Ireland only.
★ ★ ★ ★ ★
A new legend.
An old legacy.
WATERFORD®
Photo: Pesin
Illustrated booklet
Waterford Crystal
225 Fifth Avenue
New York 10010

5.06(747)M1
Ref.

NATURAL HISTORY



4/81



Chrysler's K cars beat Ford Escort, Ford Granada, Mercury Lynx and Oldsmobile Cutlass Diesel after 50 tough Motor Trend test evaluations.

This year, the Motor Trend Car of the Year finalists were rated on more than 50 counts of performance, quality, comfort, and design. A 75-mile torture course, with every driving condition from freeways to twisting mountain roads, was used to evaluate the quality of ride and drive. And a panel of Motor Trend experts rated the cars on passenger comfort, styling and design, and dollar value. When the results were in, the K cars had outscored the Ford and GM contenders on an overall point basis. Everything you want in a new car, Motor Trend found in the K cars.

1981 DODGE ARIES K COUPE
41 25* $5,880**
EST. HWY. EPA EST. MPG



*Use EPA est. mpg numbers for comparison. Actual mileage may differ depending on speed, trip length and weather. Actual highway mileage probably lower, CA mileages lower.
**Base sticker prices. Sticker prices differ in the states of CA, HI, NB, LA, NJ, MA, WA, PA, MS. See your dealer for details. Standard equipment levels vary among cars. Destination charges, title and taxes extra. WSW tires $51 extra on Reliant, Aries.

The New Chrysler Corporation

Dodge Plymouth

"In this part of the new decade, passenger comfort, ride and drive, styling and design... and most important, dollar value... are more relevant than all-out performance. In these classes, the K car simply outscored its competition; and in three cases out of four, the competition turned out to be another K car. This accomplishment alone was enough to make it Car of the Year."

The Editors, Motor Trend Magazine, February issue

1981 PLYMOUTH RELIANT K SEDAN

41 25* $5,980**

EST. HWY. EPA EST. MPG.



NATURAL HISTORY

Vol. 90, No. 4, April 1981

American Museum of Natural History
Robert G. Goelet, President
Thomas D. Nicholson, Director

Alan Ternes, Editor
Judith Friedman, Managing Editor
Thomas Page, Designer
Board of Editors:
Sally Lindsay, Frederick Hartmann, Vittorio Maestro, Rebecca B. Finnell
Carol Breslin, Book Reviews Editor
Florence G. Edelstein, Copy Chief
Rita Campon, Copy Editor
Angela Soccodato, Art Asst.
Kay Zakariasen, Picture Editor
Douglas J. Preston, Publications Editor
Susan Rosenberg, Editorial Asst.
Lillian Berger
Editorial Advisers:
Malcolm Arth, James W. Atz, Niles Eldredge, Kenneth L. Franklin, E.Craig Morris, Norman Newell, Thomas D. Nicholson, Martin Prinz, Gerard Piel, Nina Root

David D. Ryus, Publisher
Bradford D. Smith, Business Manager
Frederick E. Grossman, Production Mgr.
Ernestine Weindorf, Administrative Asst.
Elaine M. Callender, Advtg. Production Mgr.

Barbara Lynn Gutman, Circulation Mgr.
Daniel J. Dynan, Asst. Circulation Mgr.
Bob Bruno, Fulfillment Mgr.
Ramón E. Alvarez, Circulation Asst.

NATURAL HISTORY *(ISSN 0028-0712), incorporating Nature Magazine, is published monthly by the American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024.*
Subscriptions: $15.00 a year. In Canada and all other countries: $18.00 a year. Second-class postage paid at New York, N.Y. and at additional offices.

Copyright © 1981 by American Museum of Natural History. All rights reserved. No part of this periodical may be reproduced without written consent of Natural History. *The opinions expressed by authors do not necessarily reflect the policy of the American Museum.* Natural History *is indexed in* Reader's Guide to Periodical Literature.

Advertising Offices:
Natural History Sales
488 Madison Avenue
New York, N.Y. 10022
President of Sales, Arthur Hill Diedrick
Advertising Manager, Katherine José

Telephone Numbers:
Advertising Sales (212) 826-9467
Museum Information (212) 873-4225
Subscription Orders (800) 526-0331 outside N.J.
(800) 932-0834 in N.J.

Change of address notices, undeliverable copies, orders for subscriptions, and other mail items are to be sent to
Natural History Membership Services
Box 4300
Bergenfield, New Jersey 07621

4 Authors

8 The Human Strategy *Paul D. Starr and Nura S. Alamuddin*
Marriage—Lebanese Style

14 This View of Life *Stephen Jay Gould*
A Most Chilling Statement

22 Bios *Robert E. Cook*
Disturbing Plants

30 The African Elephant's Drinking Problem *James Allaway*
When development schemes are proposed, who speaks up for the elephant?

36 Bees for the Birds *photographs by Javier Echevarri and Mila Olano*
Bee eaters have to do some food preparation after they snatch their prey in the air.

40 Street Urchins of Colombia *Kirk Felsman, photographs by Anthony Boccaccio*
The city streets are both theater and battleground for these waifs.

52 From Eternity to Here
In celebration of the American Museum's newest hall, a Natural History *Special Supplement on the origin, the discovery, and the significance of meteorites.*
Long-playing Records, by John A. Wood
A Lode of Meteorites, by Brian Mason
Telltale Inclusions, by Lawrence Grossman
Cosmic Dust, by Donald E. Brownlee
At the American Museum

86 Celestial Events *Thomas D. Nicholson*

88 Additional Reading

90 Books in Review *Matt Cartmill*
Lucy in the Sand with Footnotes

96 A Matter of Taste *Raymond Sokolov*
Chili con Blarney

Cover: *Artist-scientist William K. Hartmann created this hypothetical collision between an asteroid and the earth. Such a monumental impact might have led to the extinction of dinosaurs 65 million years ago. Meteorites, which are asteroid fragments, usually fall to earth without causing serious damage. A special supplement on meteorites begins on page 52.*



Taylor California Cellars' high quality varietal wines, selling at around $4.00, are impressing wine experts all across the country.

Read what wine editor Robert Shoffner says, for example, about our Cabernet Sauvignon: "This wine is incredibly well made, with pronounced varietal character, good balance and a nice lingering finish. You just don't find this kind of class for so little money."

Enjoy Taylor California Cellars Cabernet Sauvignon and other premium varietals—Chardonnay, Chenin Blanc, Zinfandel, Riesling, and Sauvignon Blanc. At around $4.00, they offer exceptional value.

© 1981 TAYLOR CALIFORNIA CELLARS, GONZALES, CALIFORNIA 93926



Varietal wines from Taylor® California Cellars.™ Better wines. Judge for yourself.

James Allaway is a senior planner with the Land and Resource Planning Section of the Alaska Department of Natural Resources. Prior to this line of employment, he studied elephants in the lower Tana River region of Kenya. He writes that "there's a joy and exhilaration you get from elephants." He doesn't explain what he gets from working in the far north. Allaway earned his Ph.D in natural resources from Cornell University and has worked as a Peace Corps volunteer in Somalia.





As a doctoral candidate in clinical psychology at Harvard University, **Kirk Felsman** is seeking to understand how some children make healthy adaptations to conditions of severe environmental stress. His studies grew out of clinical work with children from low-income welfare families in the Boston area during which he was taken with the children's "repeated displays of strength, courage, and resiliency." Two films that deal with children who survive on the streets of major cities in Latin America led Felsman to spend a year in Colombia learning about the "gamins." The article in this issue of *Natural History* is based on that field research.

John A. Wood is a staff scientist at the Smithsonian Astrophysical Observatory in Cambridge, Massachusetts. His work on meteorites is focused on "the form and sources of the earthy materials that came to be incorporated in the solar system and the way these materials were processed and rearranged as they were being assembled into planets." Wood has also studied lunar rock samples to learn "how the materials of a small new planet first sorted themselves out into layers that are characteristic of the structure of planets."



Britain is a bargain with British Airways' Dollar Stretching Holidays.



"Once, Eliza Doolittle sold flowers here. Now, it's just bloomin' fun." *–Robert Morley*

Covent Garden. Where Professor Higgins spotted Eliza Doolittle and bet Colonel Pickering he could make her a Fair Lady. Covent Garden was then a busy marketplace of flower carts, fruit and vegetable stalls, and social activity spilling into the surrounding streets.

Today, Covent Garden survives as an amazing array of specialty stores, theatres and restaurants. Isn't it lover-ly!

Give Your Wallet A Well-Earned Rest. A 7-day "London Without Cash" holiday costs just $569 prepaid plus airfare, and includes almost everything. Room and bath at a nice, centrally located hotel. Continental breakfasts. Hearty lunches at your choice of over 100 restaurants and pubs. Elegant dinners at some of London's poshest spots. Unlimited bus and subway travel. Theatre and cinema tickets. Museum admissions. A nightclub show. A tea party. We've even included a banquet for you! Plus the morning newspaper, nightly nightcap, even postcards home.

Getting About Britain. On British Airways' "Britain Hoteltour," you can stay at a different inn every night, if you like. And you'll have a car to get you from one to the other, and to roam the countryside. Unlimited mileage. (You pay for petrol.) 7 days of travel adventure for just $279 plus airfare. Tour prices are per person, double occupancy.

Or, be on your own, in a Godfrey Davis car with unlimited mileage rented from British Airways. As little as $129 a week. (Petrol on you.) There are 160 rental locations throughout England, Scotland and Wales.

To learn about more British bargains, send the coupon for our free brochures. Then see your travel agent.

Come to life in Britain!

British Tourist Authority, Box 3150
Grand Central Station, New York, N.Y. 10017

Please send me your "Dollar Stretcher Holidays Britain and Europe," "Britain Car Rental and Hoteltour" and "Great Britain. Great Welcome" brochures.

Name _____
(please print clearly)

Address _____

City _____ State _____ Zip _____

Valid April 1st to October 31st 1981

British airways

BRITAIN
ENGLAND SCOTLAND WALES

BA-NH-04

"An elegant guided tour through the human mind."*

THE NATURAL HISTORY OF THE MIND

GORDON RATTRAY TAYLOR

Déjà-vu... telepathy... psychosomatic illness... the author of the best-selling *The Biological Time Bomb* explores many puzzles of human experience in this stimulating account of the workings of the mind—and describes in detail the anatomy and physiology of the brain, as well as the latest discoveries in neuroscience.

**N.Y. Times Book Review*

PENGUIN BOOKS Dept. ATE-NH
625 Madison Ave., New York 10022

Send me _____ copies of THE NATURAL HISTORY OF THE MIND @ $4.95. Add sales tax where applicable plus $1.25 for shipping (up to 3 copies). I enclose $_____ total.

Name _____

Address _____

City _____ State _____ Zip _____

Better Than Jogging



NordicTrack

Jarless Total Body Cardiovascular Exerciser Duplicates X-C Skiing for the Best Motion in Fitness

This revolutionary new exerciser duplicates the smooth, rhythmic, total body motion of X-C skiing for the most effective cardiovascular exercise obtainable. Uniformly exercises more muscles than any other exercise device. Makes high heart rates easy to obtain and keeps more muscles in tone. Also highly effective for weight reduction.

Completely jarless natural motion does not cause joint and back problems as in jogging or running. Arm and leg resistances are separately adjustable for maximum effectiveness. The NordicTrack uses no motors and folds compactly for convenience. Used in homes, businesses, and institutions. Our customers include Xerox Corporation, US Army, Penn State U and the YMCA.

For more info, call or write

PSI 124 L Columbia ct. Chaska, MN 55318
toll free 1-800-328-5888, MN 612-448-6987

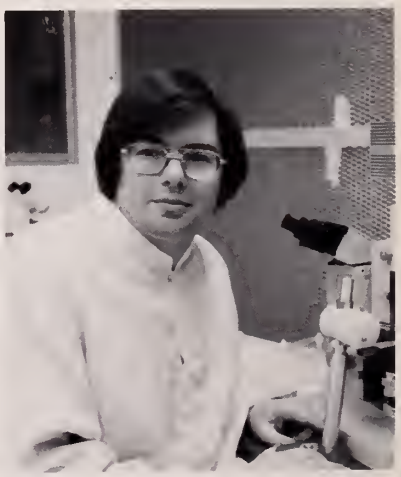
Brian Mason is curator of the Department of Mineral Sciences at the Smithsonian Institution in Washington, D.C. Born in New Zealand, he took his Ph.D. in mineralogy halfway across the world at the University of Stockholm. His interest in meteorites dates from his days as a graduate student and has caused him to concentrate on that subject for the past twenty-five years. Before going to the Smithsonian in 1965, Mason was chairman of the Department of Mineralogy at the American Museum.

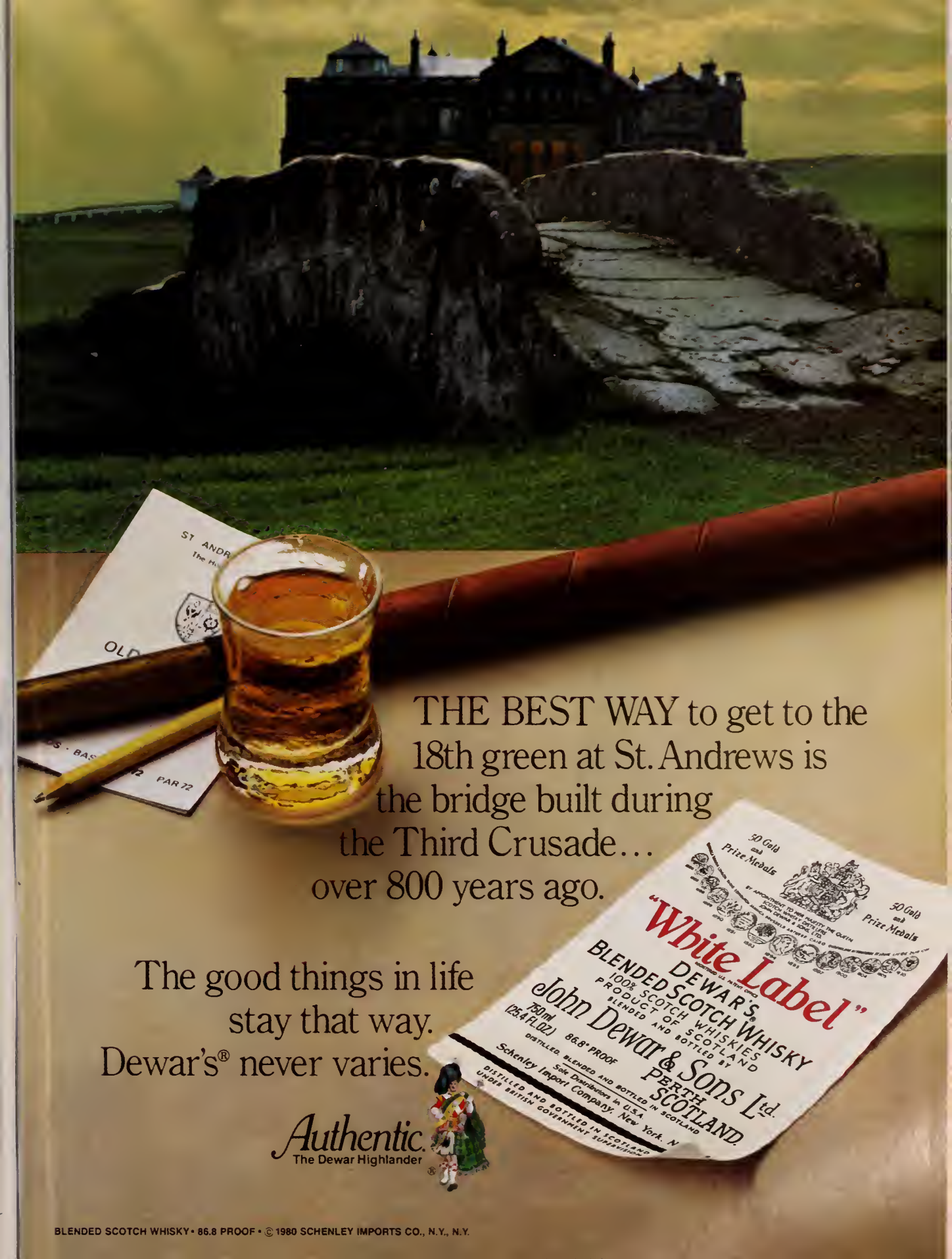




Lawrence Grossman is associate professor of geochemistry in the Department of the Geophysical Sciences and the Enrico Fermi Institute at the University of Chicago. A specialist in cosmo- and geo-chemistry, he has been a NASA consultant on lunar data and the *Mariner* Jupiter orbiter, and has lectured at the Field Museum of Natural History. One of his areas of research is the chemical and isotopic compositions of the different petrographic components of chondritic meteorites as clues to the behavior of the elements during the condensation of the solar system.

Donald E. Brownlee is associate professor of astronomy at the University of Washington in Seattle, where he earned his doctorate. His current research is directed toward the analysis of interplanetary dust from the stratosphere, coral atolls, and the ocean floor. Pursuit of that work has involved "many nights in cold observatories and an oceanographic cruise from Acapulco to Hawaii to collect cosmic dust." Most of the year Brownlee lives on a houseboat on a Seattle lake, but he also "feels a strong attraction to mountains, beaches, sand dunes, palm trees, and penguins."





BLENDED SCOTCH WHISKY • 86.8 PROOF • © 1980 SCHENLEY IMPORTS CO., N.Y., N.Y.

Marriage—Lebanese Style

Among members of the Druse sect, the marriage contract is a customary safeguard for women

by Paul D. Starr and Nura S. Alamuddin

With the women's liberation movement in the Western nations has come the proposal that couples entering into marriage negotiate an extensive contract that specifies the nature of their relationship. These agreements may include any of the financial or personal aspects of a marriage—the wife's use of her maiden name, birth control methods, whether or not to have children (and if so, the number), residence patterns, the division of household labor, the use of income, sexual rights and freedom, relationships with in-laws, and the distribution of property should the marriage end. All such provisions may not be legally binding but they can, it is argued, help us to examine the incomplete assumptions we hold about our intimate relationships and make them more equitable, satisfying, and enduring.

Marriage contracts in the industrialized West have been negotiated by a relatively few avant-garde couples, and their use strikes many as a passing fashion brought on by the push for sexual equality. But in the Middle East and other parts of the world, marriage contracts have been used by many people for hundreds, even thousands, of years.

In spite of the continuing reliance on marriage contracts throughout the Middle East, few analyses of what these agreements mean to those who use them have been possible. Shortly before the most recent Lebanese civil conflict, however, we were able to examine a large sample (3,398) of the marriage contracts negotiated by members of the Druse sect in that country from 1931 through 1974.

One of Lebanon's numerous religious sects, the Druse are also an important Arab minority group in neighboring Syria and Israel. They have continually played an important role in the history of the Levant and from the sixteenth through the eighteenth century were one of the most powerful groups in the region. Originally emerging from the sectarian turmoil of eleventh-century Cairo, the theology of the Druse includes many features that distinguish it from the mainstream of Islam. Aside from the monogamous marriage practices of the Druse, however, their contemporary way of life reflects traditional values found among most other Arab Islamic groups in the Middle East. In fact, although polygamy is permissible in other Islamic groups in the region, fewer than 3 percent of the husbands who can legally have more than one wife at the same time do so. In most respects, then, Druse marriage patterns reflect values that commonly prevail among Moslems in the Levant.

The marriage contract plays a fundamental part in the institution of marriage among the Druse. Legalizing the union, and giving it a religious sanction, a contract is usually the product of lengthy and elaborate negotiations on the part of a couple's senior kin. Some of its provisions involve only the initial establishment of the union, while others serve to help perpetuate the union or cope with its termination. The standard contract form that has been used in recent decades by the Central Druse Religious Court in Beirut includes the names, birthplaces, birth dates, and home villages of the bride and groom; the names of their fathers, deputies, and witnesses; and a place for seals and signatures. It also specifies the physical status of the bride and whether she is a virgin, a widow, or a divorcée. (Given the very strict puritanical code of the Druse, it is unthinkable that a woman could be listed as a nonvirgin and not have been previously married.) The most important part of the contract deals with the *mahr*, a payment made by the husband to the bride or her kin. There are two types of *mahr*. The first, or immediate, type is to be given before, during, or shortly after the contract-signing ceremony, and usually includes some money and such gifts as jewelry, furniture, and a sewing machine. The second, or deferred, *mahr* is a cash amount that the groom and his family agree to pay the bride in the event that he divorces her or dies before she does. Should a woman initiate a divorce, she would commonly forfeit the deferred sum.

Mahr can serve different purposes. Some regard it as purchase money, while others view it as a symbol, a ritualistic demonstration of the groom's esteem for the bride. Clearly, immediate *mahr* in the form of furniture, clothing, a sewing machine, or other goods is helpful in establishing the couple's household. The deferred *mahr* can be regarded as a kind of insurance policy to help protect the wife from the economic deprivation that she would be likely to suffer through the loss of her husband by either divorce or death. Deferred *mahr* can also reflect the degree of the husband's commitment to his spouse. Even though it is legally relatively easy for a man to obtain a divorce in the Middle East, this course of action becomes less likely, especially among rural peasants, if a husband is required to pay a large lump sum as compensation. As with so many other social inventions, the reasons for the existence of *mahr* can be as varied as the uses to which it can be put.

Given the significant role *mahr* plays during negotiations preceding a match, as well as throughout a marriage, we chose to focus our inquiry on how various characteristics of the couple influenced the amount of deferred *mahr* agreed upon.

We looked initially at how the "physical status" of the bride affected her position in the "marketplace." Vir-

You wouldn't hang a Picasso in the closet. You'd show it in its best light. Proudly. Leica feels the same way about photography. It would be a pity if pictures taken with our amazing R4 weren't projected with our equally amazing Pradolux* RT300. Each is superb. Together, incomparable.



Consider the Leica* R4: the camera that's so automatic, so responsive, it can do everything, simply. It's the only camera in the world with two independent light meter systems. You can select either full-area (averaging) or selective (spot) metering with a touch of the controls. And you have multi-mode exposure automation working with the two metering systems. Again truly unique. This gives you shutter priority, aperture priority, programmed control, metered manual and flash automation in fractions of a second. And you have a full system of accessories including motor drives and the incomparable Leica-R lenses to bring all this potential to actuality, simply.





The only slide projector made to this high standard is our own: the Pradolux RT300. It offers Leica lenses in a full range from 60 to 200mm in both curved and flat-field configurations. The internal condensers are just as important as the lenses. That's why ours are Leica optical quality, too. You can count on high efficiency cooling for long life of the projector, the lamp and your slides. The Pradolux RT300 accepts Kodak Carousel* trays and stack loaders. Plus a range of built-in features that seems to go on forever.

In fact, with both the Leica R4 camera and Pradolux RT300 slide projector you will see how impressive your images really are. Pablo. Ask your dealer for information, or write E. Leitz,* Inc. Dept. NH-4, Rockleigh, N.J. 07647.

Leitz

Leitz means precison. Worldwide.

gins were seen worthy of a much higher *mahr* than either widows, divorcées, or those described as *thayyib* (literally, "nonvirgins," also referring to widows and divorcées). The inferiority of previously divorced brides, as reported to us by various Druse informants, was apparent. Their *mahr* was less than a tenth of that for virgin brides, and less than half of that for either widows or *thayyib* women.

We looked next into the effect that the social standing of the couple's families had on *mahr*. Traditionally, Druse families are either of the sheikly class or are commoners. This distinction, based on the historic exploits of ancient nobles and warriors, is commonly known and accepted within the sect. The great majority of Druse marry within their class, with sheikly unions specifying a higher *mahr* than those between commoners. If a man of high status marries a commoner, however, he pays much less than he would for a bride from his class. Most interesting is the very high *mahr* a commoner agrees to pay for a sheikly bride. In the few instances in which a commoner has gained the hand of a sheikly bride, he has paid a high price for the status that his partner brings to the marriage. When a high-status groom has a commoner bride, however, the status he confers upon her is presumed to be an ample reward. He agrees to pay a little more than half the *mahr* given a sheikly bride.

Status is not the only social boundary that influences marriages among the Druse. As with many other Middle Eastern groups, their families have historically belonged to larger political factions. The Druse have two basic factions, the Yazbaki and the Jumblati, with a small minority of families maintaining an affiliation with both. These groups have historically been at odds over issues within the community and have often been in opposition on the larger national scene. Each has been allied with opposing coalitions made up of other Lebanese Christian and Moslem groups. Reflecting the increased liability that cross-factional marriage entails, the average *mahr* for such a match is significantly higher than a marriage within either the Yazbaki or the Jumblati faction. The lowest *mahr* was found in marriages between families that had ties to both political factions, presumably because these marriages should be less affected by internal political turmoil.

Endogamy, the custom of marrying within a particular group, is a basic feature of Middle Eastern marriages, with the strongest preference for unions between a man and his father's brother's daughter. If the most desired form is not possible, the preference is for matches within the same clan. To determine how the satisfaction of these preferences might affect the amount of *mahr* agreed upon, we examined how it was influenced by the couples being related and by their residing in the same area.

We found that marriages within the same clan had the lowest *mahr*, suggesting that the perceived liability for such matches was also low. Surprisingly, however, closeness in terms of the physical proximity of two families resulted in a lower *mahr* than did closeness in terms of kinship. For example, when the couple's families were related but separated by long distances, as in the case of a wedding between one branch of a clan that lived in Syria and another branch that lived near Beirut, the average *mahr* was much higher than when the families were unrelated but living in the same village. The conclusion that physical proximity is more desirable than closeness in terms of kinship and may promote a better marriage was also shown in other situations. Among the highest average *mahrs* were those that involved the greatest physical separation of the bride from her family, as in the case of women going to marry Lebanese immigrants living in Australia or the United States. Obviously, the greater the distance a bride is from her family, the less they are able to aid her. To compensate for this disadvantage and to increase her protection, a larger *mahr* is sought.

Observations and discussions with Druse of a variety of backgrounds indicated that personal characteristics of the potential mates, as well as those of their respective families, also produced variations in *mahr*. It is common for undesirable suitors to be turned down in a diplomatic way by demanding an exceptionally high *mahr*. If a suitor is seen as "too old" for a woman, is divorced, or has a reputation for being unstable or unreliable in some respect, a woman's parents will usually seek a very high *mahr*, to get him either to withdraw or to provide a considerable amount of "insurance" for their daughter. The general physical attractiveness, intelligence, education, and personality of those involved are also important. A highly desirable match from the point of view of the couple and families involved is seldom lost because of a lack of agreement about the *mahr*.

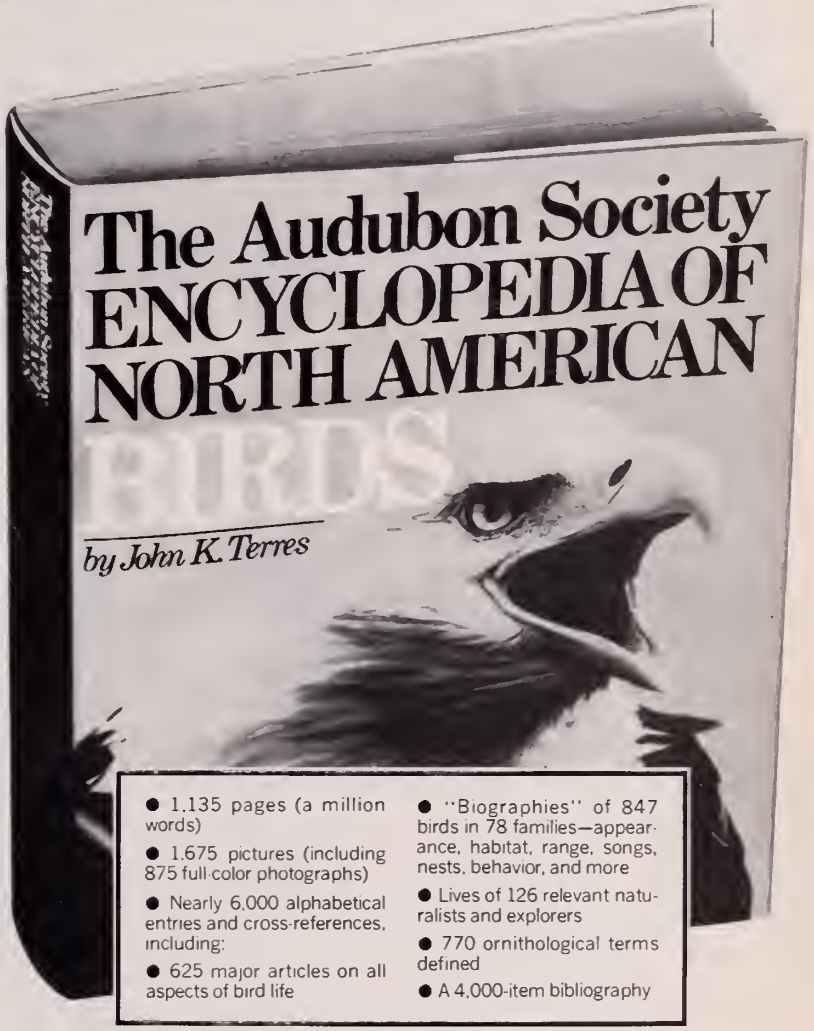
The contracts had no details about most of the personal characteristics of those married but did include their ages. This enabled us to see how differences in the ages of the bride and the groom affected the amount set. Conventionally, Druse men marry women who are about seven years younger than themselves. We anticipated that significant departures from this norm would result in a higher *mahr*. The actual situation turned out to be different. From no age difference to a difference of nineteen years, the less the age difference, the less the *mahr* specified. Clearly, the perceived liability steadily increased as the difference in age between a younger bride and an older groom became greater. But at a difference of more than nineteen years the level of *mahr* decreased significantly and then leveled off. Seeking an explanation for this phenomenon, we realized that most of these matches were what the Druse term "nurse-bride" marriages. In these unions an older man, often a widower, takes a younger bride to help cook, manage the household, and care for any infirmities he may have. A lower *mahr* is set because the wife can expect a reasonable inheritance upon the death of her aged spouse and may also anticipate marrying again. In those rare marriages in which an older woman took a younger husband, there was no clear pattern.

Because we had data covering a 44-year period, we were also able to assess the effect that tremendous economic and social changes have had upon Druse marriage patterns. Reflecting the great economic growth of Lebanon since the early 1930s, the typical *mahr* has increased sharply. During the 1930s, the average *mahr* was 220 LL (Lebanese pounds). In the early 1970s, it was 11,461 LL, an increase of more than 5,200 percent. In other respects, however, Druse marriage patterns have changed very little. Marriages between families of different social strata (sheiks and commoners) continued to be unusual, making up less than 2 percent of the total. Unions between those belonging to different political factions are more common, but the proportion—about one in four marriages—has changed little since the 1930s. Similarly, about

Why THE AUDUBON SOCIETY ENCYCLOPEDIA is hailed as

"The bird-lover's bible!"*

IT'S HUGE, unprecedented, gloriously illustrated—the first one-volume encyclopedia to provide full, concise, impeccable information on *all* the birds that nest or have been sighted in North America.



- 1,135 pages (a million words)
- 1,675 pictures (including 875 full-color photographs)
- Nearly 6,000 alphabetical entries and cross-references, including:
- 625 major articles on all aspects of bird life
- "Biographies" of 847 birds in 78 families—appearance, habitat, range, songs, nests, behavior, and more
- Lives of 126 relevant naturalists and explorers
- 770 ornithological terms defined
- A 4,000-item bibliography

Naturalists acclaim it

ROGER TORY PETERSON says, "I intend to keep my copy near my desk, for frequent use. It is a much-needed, broad-ranging accomplishment, and a most felicitous layman's reference."

DEAN AMADON, Lamont Curator Emeritus of Birds, American Museum of Natural History: "A massive achievement...I consider it to be one of the outstanding ornithological publications of this or any other time." —From his Foreword

Reviewers extol it

"I fell in love with it!" says *Newsweek*'s critic Walter Clemons. "A monumental work that happens to be irresistibly readable."

"The most impressive American bird book since John J. Audubon's *Birds of America*," says the Associated Press..."A must for serious bird students" *(Chicago Tribune)*.

***"Destined to retain its primacy for years to come,"** says John Barkham, calling it "the bird-lover's bible!"

About the author

JOHN K. TERRES, who for 13 years edited *Audubon* magazine and in 1971 received the John Burroughs Medal for distinguished nature writing, has devoted over two decades to the preparation of this book.

"Awesome," writes Edmund Fuller in the *Wall Street Journal*, "is the only word for the author's knowledge of his field...A magnificent project...the extraordinary capstone of a career."

An essential reference

"This massive work," says the *Library Journal*, "is an essential reference for all libraries serving professional or amateur ornithologists."

...and a joy to have at home

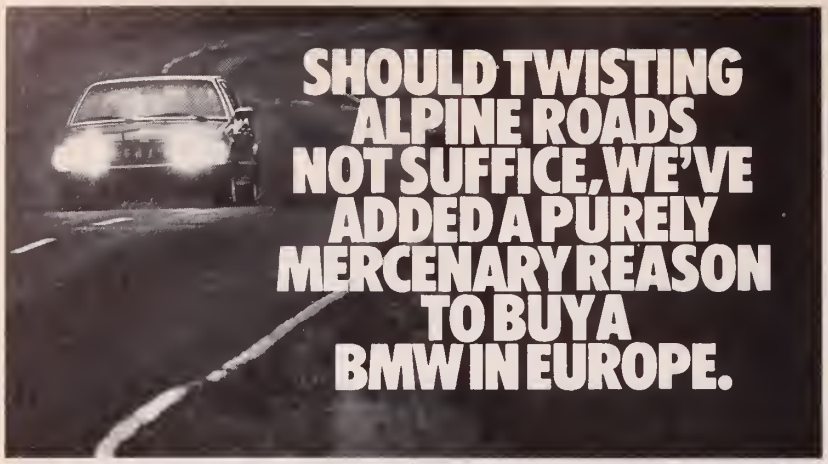
"Dazzling in its beauty and abundant in its scientific treasures," says the *Christian Science Monitor*. "Captivatingly readable...If you're not the type to sit up nights perusing dictionaries and encyclopedias, this book could very well change your reading habits."

For layman and expert

When you see it at your bookseller's, you'll want it for yourself—whether you're a dedicated life-lister, a casual nature-lover, or a naturalist.

The entrancing color photographs, the detailed drawings, the wealth of content and clarity of presentation combine to make *The Audubon Society Encyclopedia of North American Birds* a necessity—and an abiding joy—for everyone interested in birds.

9 x 11 • With 1,675 illustrations in color and black-and-white
1,135 pages • $60 at all bookstores • Published by Knopf



While the thrill of mastering a spiny Alpine road in the BMW built for it remains as potent as ever, we recognize that these are value-conscious times.

We are therefore pleased to announce that a BMW bought in Europe is now substantially less expensive than one bought in the United States.

Further, if you imagine that the joys of European Tourist Delivery are clouded by 42-page forms, rest assured. Because your BMW dealer here at home handles everything.

BMW European Tourist Delivery Program, Montvale, New Jersey 07645

Please send me more information on your 1981 European Delivery Program.

NAME _____

ADDRESS _____

NH4

CITY _____

STATE _____

ZIP _____

THE ULTIMATE DRIVING MACHINE.

BMW MUNICH GERMANY

c 1981 BMW of North America, Inc. The BMW trademark and logo are registered trademarks of Bayerische Motoren Werke, A.G.



Australia is unlike any other place on earth. You can walk back into time and leap into the future. All in the same day.

Join a rugged safari tour. Experience spectaculars like the vast Outback. The Great Barrier Reef. Living deserts and tropical rain forests.

Go game fishing, mountain climbing, camel-trekking. Ride around a sheep station. Pan for gold. Or hop off the trail and explore one of our cosmopolitan cities.

Send for our free Travel Planner. And take a tour of our continent before you come, mates.

See your Travel Agent or mail this coupon for your free Travel Planner.

Australian Tourist Commission Distribution Center, P.O. Box A-1, Dept. 151A-013, Addison, IL 60101

My special interest is _____

Name _____

Address _____

City _____ State _____ Zip _____

one-third of all marriages continue to occur within a single clan, a stable proportion. Surprisingly, and in contrast to so many other groups in the modernizing societies of the Middle East, even the Druse age at first marriage has remained fairly constant during the last four decades, averaging about twenty-one for brides and twenty-eight for grooms. In spite of the many changes that have taken place in Lebanon during the last few decades, the basic structural features of Druse society have remained amazingly resilient and express little change. During the same period the frequency of divorce also remained low, affecting an estimated less than one in ten couples.

Initially, the use of the marriage contract among the Druse would appear to be much different from that envisioned by its proponents in the West. In the Middle East, it is a long-established safeguard for women, who occupy an unquestionably inferior position in relation to their husbands. It establishes a penalty the husband must pay should he divorce his wife and helps perpetuate the marriage in spite of the wife's subservient position. It also at least partly compensates widows for the economic and personal loss incurred by the death of a spouse. On the other hand, advocates of the use of the contract in the West see it as an innovation to help couples overcome the traditional subordination of women within a marriage relationship by achieving an acceptable consensus about important individual concerns.

A closer look reveals, however, that both approaches actually seek the same end—the cultivation between men and women of enduring, emotionally satisfying relationships that create a buffer against life's stresses. That a mechanism like the marriage contract has emerged from two very different cultures suggests that it may indeed be a useful tool. In our society, where the persistent quest for "something better" often results in personal relationships that are numerous, brief, and unsatisfying, no workable alternative should be overlooked.

Paul D. Starr is associate professor of sociology at Auburn University. Nura S. Alamuddin holds graduate degrees in anthropology from the American University of Beirut and the London School of Economics.

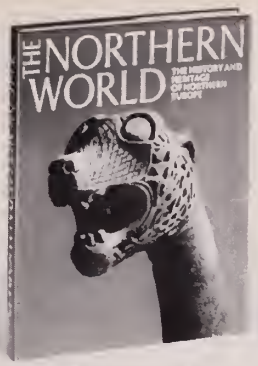
Great books at a great price.



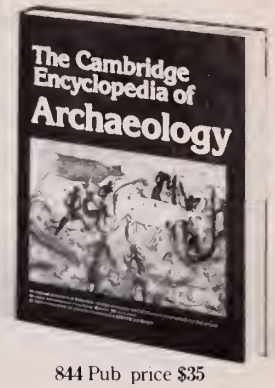
813 Pub price $30



805 Pub prices total $34.85



800 Pub price $40



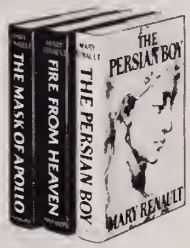
844 Pub price $35

Choose any 3 lavish books or sets for just $5 each.

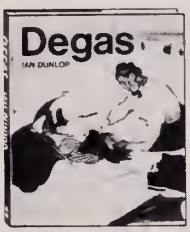
You simply agree to buy 4 books within the next two years.



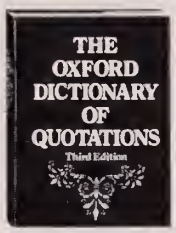
881 Pub price $30



888 Pub prices total $23.85



880 Pub price $37.50



899 Pub price $29.95



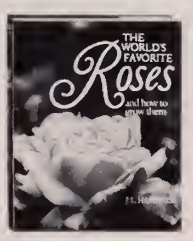
824 Pub price $32.95



861 Pub price $25



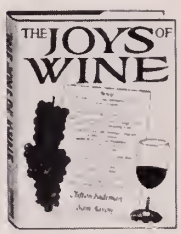
855 Pub price $32.50



883 Pub price $29.95



833 Pub prices total $46.35



803 Pub price $45



808 Pub price $17.95



825 Pub price $35

More books and sets to choose from.

885 Stories From Hans Andersen Illustrations by Edmund Dulac (Pub price $35)

•

802 The Acrylic Painting Book Wendon Blake Paintings by Rudy de Reyna (Pub price $25)

•

859 Leonardo da Vinci. Text by Jack Wasserman (Pub price $32.50)

•

828 What Is Art? An Introduction to Painting, Sculpture and Architecture. (Pub price $30)

806 Great Religions Of Modern Man (6 Vols.) Boxed. (Pub prices total $41.70)

•

809 The History Of Impressionism John Rewald (Pub price $40)

•

836 The Jewish World: History and Culture of the Jewish People. Edited by Elie Kedourie (Pub price $37.50)

•

819 William Shakespeare: A Documentary Life. S. Schoenbaum Illustrated (Pub price $50)

840 A New Age Now Begins: A People's History of the American Revolution Page Smith. (2 Vols.) (Pub price $24.95)

•

852 The Complete Sherlock Holmes Sir Arthur Conan Doyle. (2 Vols.) (Pub price $15.95)

•

882 The Gulag Archipelago, 1918-1956. (3 Vols.) Aleksandr I. Solzhenitsyn. (Pub prices total $55.50)

•

864 Saul Steinberg Harold Rosenberg (Pub price $25)

Prices shown are publishers' U.S. prices.
Outside the U.S., prices are generally somewhat higher.

BOOK-OF-THE-MONTH CLUB®

Facts About Membership

You receive the *Book-of-the-Month Club News®* 15 times a year (about every 3½ weeks). Each issue reviews a *Main Selection* plus scores of Alternates. If you want the *Main Selection* do nothing. It will be shipped to you automatically. If you want one or more Alternate books—or no book at all—indicate your decision on the reply form always enclosed and return it by the date specified. *Return Privilege:* If the *News* is delayed and you receive the *Main Selection* without having had 10 days to notify us, you may return it for credit at our expense. *Cancellations:* Membership may be discontinued, by either you or the Club, at any time after you have purchased 4 additional books.

Book-of-the-Month Club, Inc., Camp Hill, Pennsylvania 17012 **A113-4**

Please enroll me as a member of Book-of-the-Month Club and send me the 3 choices I've listed below, billing me $15, plus shipping and handling charges. I agree to buy 4 books during the next two years. A shipping and handling charge is added to each shipment.

Indicate by number the 3 books or sets you want. (These might be shipped in separate packages). | | | |

Mr.
Mrs. 1-67
Miss
(Please print plainly)

Address Apt.

City

State Zip

A Most Chilling Statement

A Russian scientist's name has been rehabilitated, and his ideas are resurfacing, too

by Stephen Jay Gould

In 1936, Trofim D. Lysenko, struggling to reform Russian agricultural science on discredited Lamarckian principles, wrote: "I am not fond of controversy in matters concerning theory. I am an ardent controversialist only when I see that in order to carry out certain practical tasks I must remove the obstacles that stand in the way of my scientific activities."

As his practical task, Lysenko set out to "alter the nature of plants in the direction we desire by suitable training." He argued that previous failure to produce rapid and heritable improvements in important crop plants must be laid to the bankrupt ideology of bourgeois science, with its emphasis on sterile academic theory and its belief in Mendelian genes, which do not respond directly to the prodding of breeders but change only by accidental and random mutation. The criterion of a more adequate science must be success in improved breeding.

"The better we understand the laws of development of plant and animal forms," he wrote, "the more easily and quickly will we be able to create the forms we need in accordance with our wishes and plans." What "laws of development" could be more promising than the Lamarckian claim that altered environments can directly induce heritable changes in desired directions? If only Nature worked this way! But she does not, and all Lysenko's falsified data and vicious polemics budged her not one inch.

If Lysenko's "obstacles" had been disembodied ideas alone, the history of Russian genetics might have been spared some of its particular tragedy. But ideas emanate from people, and the obstacles designated for removal were necessarily human. Nikolai Ivanovich Vavilov, Russia's leading Mendelian geneticist and director of the All-Union Lenin Academy of Agricultural Sciences centered in Leningrad, served as a focal point for Lysenko's attacks in 1936. Lysenko castigated Vavilov for his general Mendelian views, but any geneticist might have served equally well for such generalized target practice. Lysenko singled out Vavilov for a more specific and personal theory (and the subject of this column)—the so-called law of homologous series in variation.

Twelve years later, following the devastation of war, Lysenko had triumphed. His infamous address, "The Situation in Biological Science," read at the 1948 session of the Lenin Academy of Agricultural Sciences, contains as the first statement of its summary what may well be the most chilling passage in all the literature of twentieth-century science.

> The question is asked in one of the notes handed to me, "What is the attitude of the Central Committee of the Party to my report?" I answer: The Central Committee of the Party has examined my report and approved it [*Stormy applause. Ovation. All rise*].

Following another ten pages of rhetoric and invective, Lysenko concludes: "Glory to the great friend and protagonist of science, our leader and teacher, Comrade Stalin! [*All rise. Prolonged applause.*]"

Nikolai Vavilov was unable to attend the 1948 meeting. He had been arrested in August 1940 while on a collecting expedition in the Ukraine. In July 1941, he was sentenced to death for agricultural sabotage, spying for England, maintaining links with émigrés, and belonging to a rightist organization. The sentence was commuted to ten years imprisonment, and Vavilov was moved to the inner prison of the NKVD in Moscow. In October, he was evacuated to the Saratov prison where he spent several months in an underground death cell, suffering from malnutrition. He died, still a prisoner, in January 1943.

What is Vavilov's "law of homologous series in variation," and how did it provide Lysenko with rhetorical leverage? Vavilov published this law, the guiding principle for much of his practical work in agricultural genetics, in 1920 and revised it in 1935. It was printed in English in the prestigious *Journal of Genetics* in 1922 (vol. 12, pp. 48–89).

Vavilov was perhaps the world's leading expert on the biogeography of wheat and other cereals. He traveled throughout the world (thereby leaving himself vulnerable to trumped-up charges of espionage), collecting varieties of plants from their natural habitats and establishing the world's largest "bank" of genetic variation within major agricultural species. As he collected natural races of wheat, barley, oats, and millet over a large range of environments and places, he noticed that strikingly similar series of varieties could be found within the different species of a genus and often within species of related genera as well.

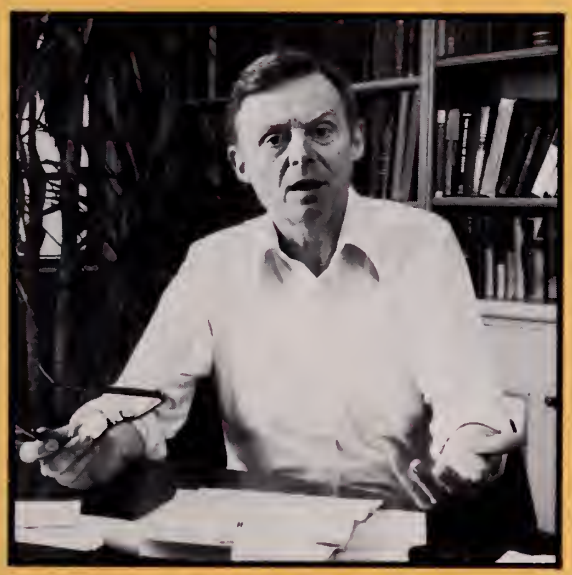
He collected, for example, a large number of geographical races within the species of common wheat, *Triticum vulgare*. These varied in complex sets of traits, including color of the ears and seeds, form of the ears (bearded or beardless, smooth or hairy), and season of maturation. Vavilov was then surprised and delighted to find virtually the same combinations of characters in varieties of two closely related species, *T. compactum* and *T. spelta*.

He then studied rye (*Secale cereale*), a species in a genus closely related to wheat but previously regarded as much more limited in its geographical variation. Yet, as Vavilov and his assistants collected rye throughout European and Asiatic Russia, Iran, and Afghanistan, he found not only that its differentiation matched wheat in extent but also that its races displayed the same sets of characters, with the same variations in color, form, and timing of growth.

The similarities in series of races were so precise and complete between related species that Vavilov felt he

Some people say...

"I moved from the suburbs to the city and my auto insurance rates went up. What's going on?"



That's why we want you to know...

People who live in cities usually pay higher auto insurance premiums than people who live in suburban or rural areas.

Why? Because car owners in large urban areas face greater exposure to loss. The concentration of people and autos inevitably results in more accidents. (Traffic experts call it "friction of the system.")

Theft and vandalism occur more frequently. And the costs of hospital and medical care, car repairs, lost wages, and lawsuits—all the things insurance pays for—are generally higher in urban areas.

Insurance companies want rates to be as fair as possible. Experience tells us the best way to do this is to charge policyholders higher or lower premiums according to their exposure to loss.

So, in making auto insurance rates, insurance companies consider the differences in costs by "territories" as an important factor.

We sympathize with those drivers whose place of residence puts them in higher rate categories. But if "territories" were eliminated, people who live in less congested areas and who, therefore, have less exposure to loss would end up subsidizing people who live in large urban areas and who have far greater exposure to loss.

And we don't think that's fair.

We're working to keep insurance affordable.

This message presented by the **American Insurance Association,** 85 John Street, NY, NY 10038

©1981 American Insurance Association

could predict the existence of undiscovered varieties within one species after finding their parallel forms in another species. In 1916, for example, he found several varieties of wheat without ligules in Afghanistan (ligules are thin membranes that grow from the base of the leaf blade and surround the stem in many grasses). This discovery suggested that varieties of rye without ligules should also exist, and he grew them from seeds collected in Pamir in 1918. He predicted that durum wheat (*Triticum durum*), then represented exclusively by spring varieties, should also have winter forms since related species do—and he found them in 1918 in an isolated region of northern Iran.

Vavilov's observation would have engendered less controversy had he not interpreted it, indeed overinterpreted it, in a manner uncongenial with strictly Darwinian or Lamarckian views. He might have argued that his series of parallel varieties represented similar adaptations of different genetic systems to common environments that engendered natural selection in the same direction. Such an interpretation would have satisfied Darwinian preferences for random variation, with evolutionary change imposed by natural selection. (It could also have been distorted by Lysenko into a claim that environments directly altered the heredity of plants in favorable ways.)

But Vavilov proposed a different explanation more in tune with non-Darwinian (though not anti-Darwinian) themes still popular during the 1920s: he claimed that the parallel series of varieties represented identical responses of the same genetic systems, inherited in toto from species to related species. Thus, in evolutionary parlance, his series were "homologous"—hence the name of his law. (Homologies are similarities based on inheritance of the same genes or structures from a common ancestor. Similarities forged within different genetic systems by selective pressures of similar environments are called analogies.)

Vavilov argued that new species arise by developing genetic differences that preclude interbreeding with related species. But the new species is not genetically distinct from its ancestor in all ways. Most of the ancestor's genetic system remains intact; only a limited number of genes are altered. The parallel varieties, then, represent a "playing out" of the same genetic capacities inherited as blocks from species to related species.

Such an interpretation is not anti-Darwinian because it does not deny an important role to natural selection. While each variety may represent a predictable latent capacity, its expression in any climate or geographical region still requires selection to preserve the adaptive variant and to eliminate others. But such an explanation does conflict with the spirit of strict Darwinism because it weakens or compromises the cardinal tenet that selection is *the* creative force in evolution. Random, or undirected, variation plays a crucial role in the Darwinian system because it establishes the centrality of selection by guaranteeing that evolutionary *change* cannot be ascribed to variation itself. Variation is only raw material. It arises in all directions or, at least, is not preferentially ordered in adaptive ways. Hence, direction is imposed by natural selection, slowly preserving and accumulating, generation after generation, the variations that render organisms better adapted to local environments.

But what if variation is not fortuitous and undirected but strongly channeled along certain paths. Then only a limited number of changes are possible, and they record the "internal" constraints of inheritance as much as the action of selection. Selection is not dormant; it still determines which of several possibilities reaches expression in any one climate or area. But if possibilities are strictly limited, and if a species displays all of them among its several varieties, then this range of form cannot be ascribed only to selection acting upon fortuitous variation.

Moreover, this explanation for new varieties undermines the cardinal principle of creativity for natural selection. The variations are predictable results within their genetic system. Their occurrence is almost foreordained. The role of natural selection is negative. It is an executioner only. It eliminates the variants unfit in any given environment, thus preserving the favored form that had to arise eventually.

Vavilov interpreted his law of homologous series in this non-Darwinian manner. "Variation," he wrote, "does not take place in all directions, by chance and without order, but in distinct systems and classes analogous to those of crystallography and chemistry. The same great divisions [of organisms] into orders and classes manifest regularities and repetitions of systems." He cites the case of "several varieties of vetches so similar to ordinary lentils in the shape, color, and size of their seeds, that they cannot be separated by any sorting machine." He agrees that the extreme similarity in any one spot is a product of selection—unconscious selection in agricultural sorting machines. But the agent of selection was, literally in this case, only a sieve that preserved one variant among many. The proper variant existed already as a realized product of an inherited set of possibilities.

The role of natural selection in this case is quite clear. Man unconsciously, year after year, by his sorting machines separated varieties of vetches similar to lentils in size and form of seeds, and ripening simultaneously with lentils. The same varieties certainly existed long before selection itself, and the appearance of their series, irrespective of any selection, was in accordance with the laws of variation.

Vavilov, overenthused with his own idea, went on. He became intoxicated with the notion that his law might represent a principle of ordering that would render biology as exact and experimental as the "hard" sciences of physics and chemistry. Perhaps genetic systems are composed of "elements." Perhaps the geographical varieties of species are predictable "compounds" that arise inevitably from the union of these elements in specified mixtures. If so, the ranges of biological form within a species might be laid out in a table of possibilities similar to the periodic table of chemical elements. Evolution might be deduced from genetic structure itself; environment can only act to preserve inherent possibilities.

He advocated an explicit "analogy with chemistry" in the concluding section of his 1922 paper and wrote: "New forms have to fill vacancies in a system." He experimented with a style of notation that expressed varieties of a species as a chemical formula and advocated "the analogy of homological series of plants and animals with systems and classes of crystallography with definite chemical structures." One zealous supporter commented that "biology has found its Mendeleev."

Vavilov moderated his views during the 1920s and early 1930s. He learned that some of the parallel varieties between species are not based upon the same genes after all, but represent

Why a Hasselblad costs more than other cameras.



It takes a full year to make a Hasselblad camera. Almost every part right down to the smallest screw, is made by Hasselblad. There is no mass production involved. All the parts are assembled by hand, and fit together with extraordinary precision.

A Hasselblad is designed and constructed to give long years of optimum performance to the professional photographer, who depends on his camera for his livelihood. Consequently, a Hasselblad camera is both rugged and sensitive—an exquisitely responsive photographic instrument of the sturdiest construction.

Because a Hasselblad gives performance far beyond that of other cameras, the Hasselblad design philosophy centers around "continuity"



rather than "obsolescence". New accessories will fit Hasselblad cameras of 20 years ago.

In the long run, a Hasselblad not only pays for itself by its performance, but also retains its value. In fact, Hasselblad cameras have been sold, after years of usage, for more than twice the original purchase price.

Hasselblad is founded on the principle of interchangeability of parts, so once you own a Hasselblad camera, you have access to the entire Hasselblad System—the most comprehensive of its kind.

There are four camera models to choose from.

First, there is the Hasselblad 500 C/M, with leaf shutter and flash synch speeds up to 1/500 second.

A more specialized camera is the Hasselblad Superwide C/M, with a built-in wide angle lens that gives a distortion-free 90° angle of view.

The 500 EL/M motor Hasselblad, ideally suited for fast shooting and remote control operation.

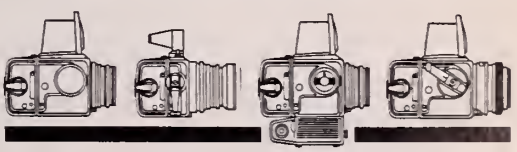
And then, the superb Hasselblad 2000 FC, with an electronically-controlled shutter that provides speeds up to 1/2000 second.

As your needs grow, you can modify your Hasselblad accordingly by interchanging the lenses, viewfinders and film backs, as well as utilizing any of the numerous accessories.

You can even change film formats—something you can't do with other cameras. For example, you can shoot in the truly ideal 2¼" square format that makes it easy to view, frame and focus, and that results in an image 3½ times larger than 35mm. Or simply snap off the film magazine back and instantly replace it with a 6 x 4.5 cm format magazine, which enlarges to 8" x 10". Your third choice is to shoot "superslides" that project on any 35mm projector, but give you twice the image area of 35 mm, dramatically filling the screen.

So, while a Hasselblad costs more, it's easy to see why so many serious photographers feel they can't afford to be without it.

See your Hasselblad franchised dealer or write for one of our bulletins on square composition, and a comprehensive brochure on the Hasselblad system to: Victor Hasselblad Inc., Dept. A-14, 10 Madison Road, Fairfield, N.J. 07006.



HASSELBLAD®

When you shoot for perfection

WILD FINNISH ADVENTURES FOR HIKERS, BIKERS, CANOERS & SAILORS.

To: Finnair, P.O. Box 32,
Irvington, N.Y. 10533

Please rush me your free color brochure on Finland Adventure Tours for hikers, bikers, canoers and sailors before I go wild.

Name _____

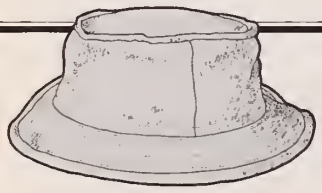
Street _____

City _____

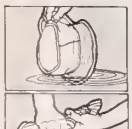
State _____ Zip _____

FINNAIR

NH4 Great vacations start with the Flying Finnish



THICK 'N THIRSTY TOWELING HAT



Thirsty terry cloth toweling is shaped into a hat that beats summer heat. Use it to wipe your perspiring brow or douse it in water, wring it out and wear it to keep you cool at tennis, golf, boating, fishing, camping. **Sizes:** S(6¾-7⅛), M(7-7⅛), L(7¼-7⅜), XL(7½-7⅝), XXL(7¾-7⅞). **Colors:** Sailing Blue, Powder Blue, White, Yellow. **Toweling Hat $7.75** ppd.

Order Today! Money Back Guarantee!

Enclosed is my check or money order for $ _____
(Add sales tax where applicable.)

Please RUSH my # 2002 Toweling Hat

Size _____ Color _____

Name _____

Address _____

City _____

State _____ Zip _____

☐ **Send me your FREE color catalog of quality outdoor apparel and equipment.**

Eddie Bauer®

Dept. ENH, Fifth & Union, Seattle, WA 98124

the similar action of selection upon different sources of variation. In these cases, the varieties are analogous, not homologous, and the Darwinian explanation must be preferred. He wrote in 1937:

> We underestimated the variability of the genes themselves. . . . At the time we thought that the genes possessed by close species were identical; now we know that this is far from the case, that even very closely related species which have externally similar traits are characterized by many different genes. By concentrating our attention on the variability itself, we gave insufficient attention to the role of selection.

Still, Vavilov continued to champion the importance and validity of his law, and he continued to advocate the analogy with chemistry in only slightly weakened form.

Unfortunately, in the deepest sense, Vavilov had left himself open to Lysenko's polemical attack. The law of homologous series provided Lysenko with important ammunition, and Vavilov's overextended chemical analogy deepened his troubles. Lysenko caricatured Vavilov's law in 1936 by presenting ridiculous examples involving species too distantly related to present parallel series in Vavilov's system: "In nature we find apple trees with round fruit, hence there must or can be trees with round pears, cherries, grapes, etc."

Lysenko's ideological attack was more vicious. He made two major charges involving both parts of that catchword for official Soviet philosophy—dialectical materialism. Vavilov's law, he claimed, was undialectical because it located the source of organic change within the genetic systems of organisms themselves and not in the interaction (or dialectic) between organism and environment. Secondly, Lysenko charged that the law of homologous series was "idealist" rather than materialist because it viewed the evolutionary history of a species as prefigured in the unrealized (and therefore nonmaterial) capacity of an inherited genetic system.

Evolution, Lysenko charged, is almost an illusion in Vavilov's scheme. It represents a mere playing out of inherited potentials, not the development of anything new. It expresses the bourgeois penchant for stability by depicting apparent change as a superficial expression of underlying constancy. According to Vavilov's law, Lysenko charged,

> New forms result not from the development of old forms, but from a reshuffling, a recombination of already existing hereditary corpuscles. . . . All the existing species existed in the past, only in less diverse forms; but every form was richer in potentialities, in its collection of genes.

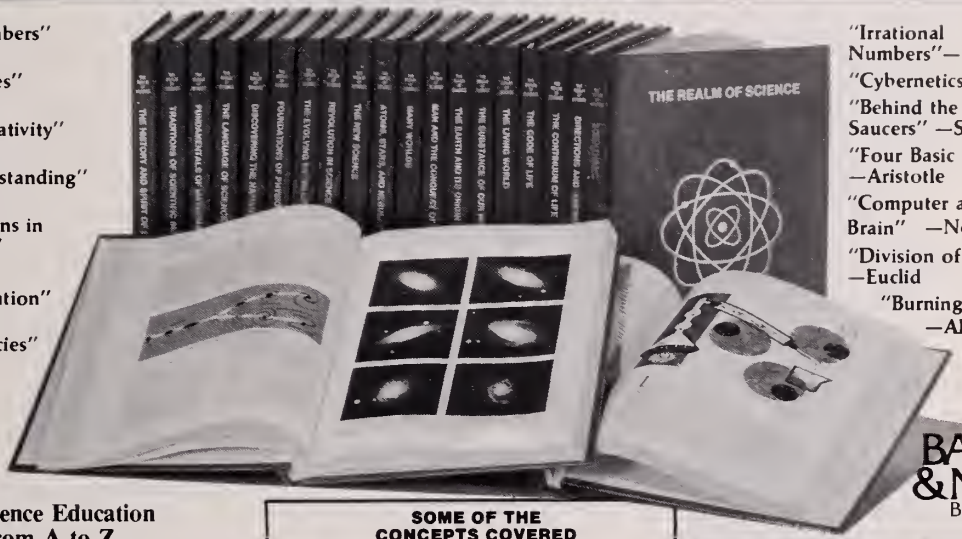
Madness often displays a perverse but cogent reason in its own terms; and we must admit that Lysenko did identify and exploit the true weaknesses in Vavilov's argument. Vavilov did underplay the creative role of environment, and his chemical analogy did betray a belief in prefigured potentiality as the source of later, and in some sense illusory, change. But Lysenko, who was also both a charlatan and a cruel polemicist, was equally undialectical (despite his protestations to the contrary) in viewing plants as putty before a molding environment.

The Soviets killed Vavilov in the name of a phony Lamarckism. He became a legitimate martyr in the West, but his ideas did not flourish as a result. The law of homologous series, the organizing theme of his evolutionary work, was ignored in the name of an overly strict Darwinism. Vavilov's law did not directly contradict Darwinian principles, but its emphasis on constraints of inheritance and channeled variation fit poorly with the favored Darwinian theme of random variation and the guidance of evolutionary change by natural selection. It was therefore neglected and relegated to the shelf of antiquated theories that had implicated variation itself as a directing force in evolution. I have consulted all the founding documents of the "modern synthesis," the movement that established our present version of Darwinism between the late 1930s and the 1950s. Only two mention Vavilov's law of homologous series, each in less than one paragraph.

Yet I feel that in his imperfect way Vavilov had glimpsed something important. In more modern terms, new species do not inherit an adult form from their ancestors. They receive a complex genetic system and a set of developmental pathways for translating genetic products through embryology and later growth into adult organisms. These pathways do constrain the expression of genetic variation; they do channel it along certain lines. Natural selection may choose any spot along the line, but it may not be able to move a species off the line—for selection can only act upon the vari-

Now You Can Own a 21-Volume Science Library Written by the "Greatest Scientists of All Time".

"Men and Numbers" —Muir
"Celestial Bodies" —Copernicus
"Theory of Relativity" —Einstein
"Human Understanding" —Locke
"Communications in the Space Age" —Kappel
"Creative Evolution" —Bergson
"Origin of Species" —Darwin



"Irrational Numbers"—Dedekind
"Cybernetics" —Wiener
"Behind the Flying Saucers" —Scully
"Four Basic Elements" —Aristotle
"Computer and the Brain" —Neumann
"Division of Figures" —Euclid
"Burning-sphere" —Alhazen

BARNES & NOBLE BOOKSTORES

A Science Education from A to Z

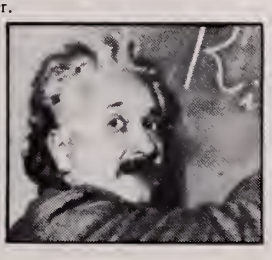
From the *ABC of Relativity* by Bertrand Russell, to Zeno's paradoxes, this 21-volume library provides a complete and fascinating science education.

Unlike an encyclopedia, this reference work is one you can read for pure enjoyment as well as refer to for reliable information. The key to this readability is the fact that THE REALM OF SCIENCE is actually a massive collection of selected writings arranged and indexed by subject. It is so complete, that the cumulative index alone runs almost 200 pages!

Think of a subject, look it up, and read what the world's foremost authorities have written about it.

The Greatest Minds the World Has to Offer

The authorities represented in this priceless collection read like a "Who's Who" in science. There's Priestley on the discovery of oxygen; Faraday on electrochemistry; E.O. Wilson on sociobiology; Ernst Nagel on Godel's proof. Plus Isaac Asimov, Jacob Bronowski, Martin Gardner, Max Planck, James Watson, George Gamow, Fritz Zwicky, and hundreds more. From ancient Babylonia to the present, you will be exposed to the greatest minds the world has to offer.



Einstein's special theory of relativity changed our concept of time, distance and mass.

A Valuable Research Tool

Although each volume contains its own index, the unique Science Concept Index "brings it all together." It will help you find vital information on a given subject, person, place or idea throughout the set. It will also enable you to trace various applications of a subject from one author to another, from one concept to another, or from one discipline to another. Imagine what a valuable research tool this can be. Taken as a whole, this 21-volume set provides an overview of science never before possible in a single work.

SOME OF THE CONCEPTS COVERED

- —Air
- —Astronomy
- —Atoms
- —Axioms-Laws-Principles
- —Behavior
- —Biology
- —Cells
- —Chemistry
- —Communication
- —Computers
- —Conservation
- —Continuity
- —Cosmology
- —Desert
- —Earth
- —Ecology
- —Electricity and Megnetism
- —Elements
- —Embryology
- —Energy
- —Entropy
- —Equilibrium
- —Evolution
- —Force
- —Genetics and Heredity
- —Geology
- —Grevity
- —Heat
- —Heredity
- —Instruments and Apparatus
- —Intinity
- —Insight
- —Knowledge
- —Light and Optics
- —Logic
- —Man
- —Methematics
- —Matter
- —Meesurement
- —Mechanics
- —Metabolism
- —Molecules
- —Motion end Momentum
- —Nebulae
- —Nucleer
- —Oceens, Seas and Water
- —Peredoxes
- —Parity
- —Photosynthesis
- —Physics
- —Planets
- —Pollution
- —Population
- —Radiation
- —Relativity
- —Reproduction
- —Space
- —Structure end Form
- —Systems
- —Technology
- —Tempereture
- —Time

SAVE $110

Pub. at	B&N Price
~~$149.95~~	$39.95

Act Now. . . Our Supply is Limited

THE REALM OF SCIENCE originally sold for $149.95. Until the supply lasts (We purchased the remaining inventory from the publisher), Barnes & Noble is offering the complete 21-volume set for only $39.95. That's about one-fourth of its original price. . . a discount of 73 percent!

Act now, and you won't be disappointed. (Each big 8" *x 10"* hardcovered volume contains almost 200 pages and is fully illustrated.) If you are not completely satisfied with the set, return it within 30 days and the purchase price will be refunded.

73% Off! BARNES/SALE & NOBLE/ANNEX

0361F

MAIL TO:
BARNES & NOBLE SALE ANNEX,
DEPT. RS451
126 FIFTH AVE., N.Y., N.Y. 10011

Please send me_____set(s) of *The Realm of Science* at only $39.95 each, plus $3.00 postage and insurance charge (N.Y. residents: Please add sales tax). If I am not completely satisfied, I may return it within 30 days for a full and prompt refund or credit to my charge account.

☐ A check or money order is enclosed.
☐ Please charge this purchase to:

☐ VISA ☐ AMERICAN EXPRESS Card ☐ MasterCard 4 digits above your name

Account # _____

Exp. date _____

Signature _____

Please print clearly

Name _____
Address _____
City _____
State _____ Zip _____

Order subject to acceptance by Barnes & Noble Bookstores, Inc

For Faster Service
CREDIT CARD CUSTOMERS CALL TOLL FREE
1-800-228-2051/Ext.15
Lines are open 24 HOURS
7 DAYS A WEEK
In Nebraska call 402-571-4900

1981 Barnes & Noble Bookstores Inc

Small Ad for a Big Tour of the Orient



Japan Air Lines has 35 very special tours to the Orient. Come, let us take you to the Orient of your dreams.
Here is but one example:
Mandarin Orient, 19–24 days, $3197–3675. All tours visit Hong Kong, Peking, Shanghai and Canton. Some tours also visit Tokyo, Penang, Singapore, Bangkok as well as certain cities in China. All tours fully escorted and most meals are included.

Rates based on double occupancy and economy air fare from the West Coast and are subject to change. Additional charge for June–October peak season.

CALL TOLL FREE
800-835-2246,* Ext. 143
for free tour information, see your travel agent, or mail this coupon today.
Japan Air Lines, P.O. Box 10618
Long Island City, New York 11101

JAL HAPPY HOLIDAYS
JAPAN AIR LINES

Dear JAL: I've read your small ad and I'd like more details of the tours I've checked.
☐ Mandarin Orient (3005)
☐ Other Happy Holidays Tours

Name_____
Address_____
City_____ State_____ Zip_____
Travel Agent_____ NH 0481
*Continental U.S. only. In Kansas: 800-362-2421

SPEND A WEEK AT CORNELL!
1981 SEMINARS IN ORNITHOLOGY
CORNELL LABORATORY OF ORNITHOLOGY
now is offering summer seminars in ornithology in addition to its popular Home Study Course in bird biology.



Our summer courses are designed to extend and complement the Home Study Course with personalized instruction and laboratory and field exercises. You will have an opportunity to select one or more of three one-week, non-credit summer seminars in bird biology. The courses are taught at the Laboratory of Ornithology and are offered at three levels: beginning, intermediate, and advanced. Topics covered include methods of field identification by sight and sound, avian ecology, anatomy and physiology, and much more. The tuition fee includes room and board. Enrollment in the summer courses is limited, so don't delay. Write now for further information.

For more information about our Home Study Course and our 1981 Summer Seminars in Ornithology write:
Dept. NH, 159 Sapsucker Woods Road, Ithaca, NY 14850.

ation presented to it. In this sense, constraints of variation may direct the paths of evolutionary change as much as selection acting in its Darwinian role as a creative force.

I have found Vavilov's views very helpful in reorienting my own thinking in directions I regard as more fruitful than my previous unquestioned conviction that selection manufactures almost every evolutionary change. In studying the relationship of brain size to body size, biologists find that brains increase only one-fifth to two-fifths as fast as bodies in comparisons of closely related mammals differing only (or primarily) in body size—adults within a single species, breeds of domestic dogs, chimpanzees versus gorillas, for example. For ninety years, the large literature has centered on speculations about the adaptive reasons for this relationship, based upon the (usually hidden) assumption that it must arise as the direct product of natural selection.

But my colleague Russell Lande recently called my attention to several experiments on mice selected over several generations for larger body size alone. As these mice increased in size across generations, their brains enlarged at the characteristic rate—a bit more than one-fifth as fast as body size. Since we know that these experiments included no selection upon brain size, the one-fifth rate must be a nonadaptive side product of selected increase in body size alone. Since the one-fifth to two-fifths rate appears again and again in diverse lineages of mammals, and since it may record a nonadaptive response of brains to selection for larger bodies within mammalian developmental systems, the parallel sets of races and species arrayed along the one-fifth to two-fifths slope in carnivores, rodents, ungulates, and primates are non-Darwinian homologous series in Vavilov's sense.

In personal research on the West Indian land snail *Cerion*, my colleague David Woodruff and I find the same two morphologies again and again in all the northern islands of the Bahamas. Ribby, white or solid-colored, thick, and roughly rectangular shells inhabit rocky coasts at the edges of banks where islands drop abruptly into deep seas. Smooth, mottled, thinner, and barrel-shaped shells inhabit calmer and lower coasts at the interior edges of banks, where islands cede to miles of shallow water. The easiest,

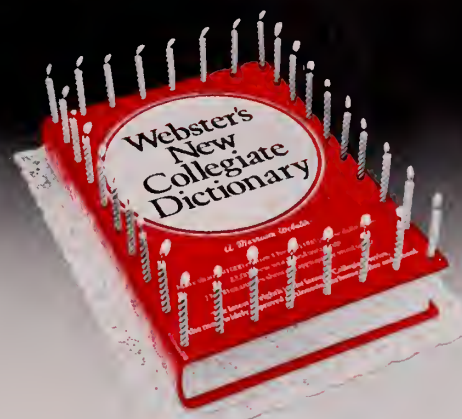
and usual, conclusion would view ribby shells on all islands as closely related and smooth shells as members of another coherent group. But we believe that the complex set of characters forming the ribby and smooth morphologies arise independently, again and again. On the islands of Little Bahama Bank, both ribby and smooth animals share a distinctive genital anatomy. On the islands of Great Bahama Bank, both ribby and smooth develop an equally distinctive, but different, kind of penis. The ecology of rocky versus calm coasts may select for ribby and smooth morphologies as adaptations, but the coordinated appearance of the half dozen distinctive traits of each morphology, again and again, may represent a channeling of available variation to produce homologous series (ribby and smooth varieties) in different lineages (defined by genital anatomy).

A complete theory of evolution must acknowledge a balance between "external" forces of environment imposing selection for local adaptation and "internal" forces representing constraints of inheritance and development. Vavilov placed too much emphasis on internal constraints and downgraded the power of selection. But Western Darwinians have erred equally in practically ignoring (while acknowledging in theory) the limits placed upon selection by structure and development—what Vavilov and the older biologists would have called "laws of form." We need, in short, a real dialectic between the external and internal factors of evolution.

Vavilov's personal tragedy cannot be undone. But he has been rehabilitated in Russia, where the All-Union Society of Geneticists and Selectionists now bears his name. We who view him as a martyr and champion his name while ignoring his ideas would do well to reconsider the older non-Darwinian tradition that he represented. Combined with our legitimate conviction about the power of selection, the principle of homologous series (and other "laws of form") might foster an evolutionary theory truly synthetic in its integration of development and organic form with a body of principles now dominated by ecology and the effects of selection upon single genes and traits.

Stephen Jay Gould teaches biology, geology, and the history of science at Harvard University.

ses·qui·cen·ten·ni·al



Webster's New Collegiate Dictionary. It's where the words live.

For 150 years, G. & C. Merriam has been bringing the language to life and life to the language. Today, the best-selling Webster's New Collegiate offers 150,000 words, including 22,000 new entries. Get a taste of "Fast Food," feel an affinity for "Clone," and share in the celebration of our "Sesquicentennial." In 150 years, dictionary has never meant so much. Just $12.95, indexed. A gift of lasting value.

FROM MERRIAM-WEBSTER®

© G & C MERRIAM 1980

UNUSUAL.



That's the ideal description of the regal island country of Sri Lanka, once known as Ceylon. It's a fabulous spectacle. Whether you're looking at our ancient cities, wondrous wildlife or miles of beaches. The ultimate is our festival of the August moon. Located in the Jasmine-scented, mountain city of Kandy, you will feast your eyes on a thousand whirling dancers, a hundred costumed elephants, and more drummers than you've ever seen. The torchlight acrobatics of this 2,000 year old Perahera will, in just a few days, leave you with a lifetime of memories.

We have an unusual variety of tours – 75 in all – ranging from 3 to 21 days. The prices? Unusually low! Accomodations begin at $5. Deluxe sells for $45.

Sri Lanka is a most unusual warm weather vacation or convention spot. Only one hour from India, three hours from Katmandu, Bangkok and Singapore. Write for a color folder and tour digest that includes special airfare.

sri Lanka
Pearl of the Indian Ocean.

Ceylon Tourist Board/Dept. NH14
609 Fifth Avenue, New York, N.Y. 10017

Name _____

Address _____

City/State/Zip _____

Disturbing Plants

Violence is a natural part of all plant communities; a disturbance that devastates one species may create opportunities for another

by Robert E. Cook

The English painter J. M. W. Turner certainly captured the sublime, violent power of nature in his art. In 1810 he exhibited a landscape, *Cottage Destroyed by an Avalanche,* accompanied by the following lines:

The downward sun a parting
sadness gleams
Portentous lurid thro' the
gathering storm;
Thick drifting snow, on snow,
Till the vast weight burst
thro' the Rocky barrier;
Down at once, its pine clad forests,
and towering glaciers fall,
the work of ages
Crashing through all! extinction follows
And the toil, the hope of
man—o'erwhelms.

Surging diagonally across the canvas, a rush of rock and white ice carry massive boulders down an Alpine slope against a wild, darkening sky. Along the base of the painting, small, spiky conifers accentuate the vast scale of the devastation. Amidst these trees, a wooden cottage is splintering beneath the debris. Turner's vision of a capricious, catastrophic nature strongly suggests a revolutionary reaction against the classical tradition of stability in landscape. In the classical style, so characteristic of the European painters Claude Lorrain and Nicolas Poussin, the quiet, pastoral countryside is drawn with strong vertical and horizontal lines of stately foliage and massive architecture, perpetuating a sense of order and permanence in nature.

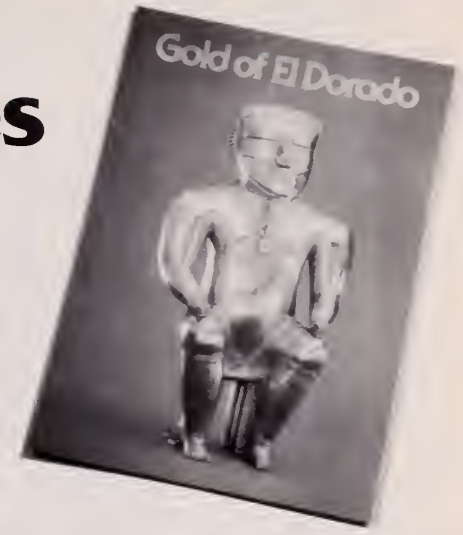
One might expect to find such strikingly different interpretations of landscape only among artists. Plant ecologists, however, are currently in the midst of a similar revolutionary revision of deeply held convictions concerning natural vegetation. In particular, old notions about the stability of the American wilderness before the European settlers arrived have been severely shaken by reconstructions of vegetational history. Before discussing these new views, however, I should sketch the origins of our traditional wisdom.

The Moses of American plant ecology is Frederick E. Clements, who, at about the turn of the century, was the first naturalist to frame a comprehensive and intricate theory of plant communities. Because he studied the dynamics of vegetation and not the flora of a region, Clements considered himself an ecologist rather than a plant taxonomist, who identifies the species composition of plant communities. The study of vegetation is concerned with the behavior of the plant ensembles in a habitat, their biomass, relative abundances, and structural relations. More than a listing of species, this approach tries to relate these characteristics of the whole community to aspects of the physical environment, such as precipitation, soil conditions, and growing season.

Clements believed that the vegetation in a region is a living entity, a superorganism, capable of progressive development, stable maturity, and reproduction. During this period in the history of biology, organismic metaphors were most attractive to scientists. Clements gave the name climax plant community to what he considered the adult form of vegetation in a region, the primeval virgin landscape that existed before the coming of settlers with ax and plow. Climax communities, which in Clements's view represented the highest development of vegetation, once covered vast tracts of continental land and were dominated in each region by a few characteristic species determined by climate. In New England, for instance, the classical climax forest (which stretched, unbroken, from Nova Scotia to Wisconsin) was a mixture of ancient beeches, hemlocks, and sugar maples.

Arrayed against these vegetational entities, Clements saw the forces of destruction: tornadoes, landslides, fires, and humans. To cope with these assaults, he argued, vegetation has evolved a mechanism of self-replication, or repair, called succession. After a patch of vegetation is devastated,

An Art Book That Took Centuries To Create



It took the American Museum of Natural History four years to arrange its exceptional exhibition of more than 500 pieces of ancient gold from Colombia. But those few years are a brief time when compared with the decades archeologists have spent digging (literally!) and studying the gold artifacts from tombs, caves, and buried sites. And all that time is short when compared with the many centuries prehistoric Indians practiced their craftsmanship and artistry to create these treasures.

So when it became the United States sponsor for this outstanding collection, the American Museum faced a dilemma. Could we do justice to all this effort and scholarship and beauty? We think we have. First, by dramatically displaying *Gold of El Dorado: The Heritage of Colombia* in one of our largest halls. The glowing reports from visitors tell us our efforts have been worthwhile. If you don't have a chance to see the show for yourself in New York, we hope you will see it in Chicago, San Francisco, or New Orleans on its year and a half tour.

The second challenge for the American Museum was the creation of an appropriate book to accompany the exhibition. We decided against a traditional catalog; against a small, boring volume with tiny black-and-white pictures that could never do justice to these fine objects. Instead, we decided to present a select number of the finest pieces of pre-Columbian gold in a large, stunning format. And to represent the three important elements that make a great art book we chose outstanding professionals.

First, photographer Lee Boltin. One of the greatest photographers of art objects, he also took the famous pictures of the Tutankhamun show. We sent him abroad to find and record great pieces of pre-Columbian art.

Second, archeologist Warwick Bray, from the University of London. One of the world's foremost authorities on pre-Columbian art, Bray is also a skilled writer, able to present fascinating background in a succinct, readable essay in the book. Dr. Bray organized the Colombian gold exhibition in London.

Third, Harry N. Abrams, Inc., America's leading publisher of fine art books. In a co-publishing venture with the American Museum, Abrams designed the book, supervised the preparation of 30 large color plates, and monitored the fine-quality printing.

The result is an unprecedented exhibition book. It is bold and big—each plate is 16 by 11½ inches—bigger than this magazine *opened up*. The paper is heavier than most posters. In fact, many persons have purchased two copies of the book in order to have one set of these fine art prints for framing.

And now for the happy ending. Because the Museum is a co-publisher, we are able to offer this soft-bound art book at a major savings from its normal retail price of $12.50. We are pleased to offer *Gold of El Dorado* to subscribers for only $6.25—a 50% savings off its regular price. This special offer is valid only during the exhibition and only while our limited supply lasts. We suggest that you order one or more copies immediately. Of course, if you are not satisfied after you have had an opportunity to examine it in your home, simply return the book and the Museum will refund the purchase price.

Natural History Books

Gold of El Dorado Book
American Museum of Natural History
77 West 77th Street
New York, N.Y. 10024

YES, I want to purchase _____ copy/copies of the Gold of El Dorado book. I ☐ enclose payment of/☐ authorize you to charge me $6.25 per copy (plus $1.00 for shipping and handling).

My name _____

My address _____

City _____ State _____ Zip _____

For charge orders only:

Charge to: ☐ Master Charge ☐ VISA
☐ American Express ☐ Diners Club

Interbank # (Master Charge Only) _____

Account # (All digits) _____

Expiration Date _____

Signature _____
(required if using credit card)

Order

_____ book(s) @ $6.25 $____

Shipping and handling $1.00

N.Y. Sales Tax (if applicable) ____

TOTAL $____

(Make checks payable to American Museum of Natural History)

the denuded site is colonized by a sequence of species that gradually alters the habitat in ways favoring a return to the structure and content of the original climax composition. Clements viewed the successional changes initiated by external disturbance as part of a progressive, internally controlled process of development, analogous to the transformations in the ontogeny of an organism. The natural state of vegetation, then, is mature climax: permanent and perpetually stable, although marred occasionally by transient patches of successional plant communities, the kinds of herbs and shrubs that colonize abandoned farmland before the mature forest develops.

This view of disturbance as a violent force external to stable vegetation had some direct effects on wilderness-preservation policies. About the turn of the century, when large expanses of forest were set aside as public land, a major priority was the establishment of a system of fire suppression. Isolated fire guards in mountain watchtowers, highly trained platoons of firefighters, and complex systems of weather forecasting all proliferated in national parks and forests, accompanied by public exhortations proclaiming the evil of fire caused by the careless hand of man. Economic and safety considerations also shaped the policy of fire suppression, but conservationists and plant ecologists alike, wishing to preserve some virgin wilderness, accepted unquestioningly the beneficial effects of such policies on forest preservation. The destructive effects of fires set by humans were seen as a tremendous threat.

Just how frequent were catastrophic fires prior to the arrival of settlers? To answer this question, Miron Heinselman, a forest ecologist at the University of Minnesota, spent six years carefully reconstructing, back to A.D. 1595, the fire history of virgin coniferous forests in the Boundary Waters Canoe Area of northern Minnesota. By probing the historical accounts of explorers and trappers and the records of geologic surveys and the Forest Service, Heinselman was able to reconstruct a history of recurrent fire. He then mapped the distribution of forest communities, particularly noting fire-adapted species, such as jack pine, whose seedlings germinate and establish primarily after burning. Heinselman supplemented this analysis with age records of individual trees, determined by counting the annual rings in a core of wood sampled from the trunk. By analyzing the history of close to a million acres, he has identified large stretches of landscape that have experienced one or more burns and can precisely establish the time of each fire.

Since 1900, when the Forest Service began its policy of fire suppression, relatively few major burns have occurred in the Boundary Waters Canoe Area, with an average interval of twenty-six years between significant fires anywhere in the forest. During the fifty years of settlement prior to the adoption of fire-suppression policies, a serious fire destroyed some part of the forest every two years. More surprising, Heinselman discovered that fires were occurring nearly as frequently—at intervals of only four years—for the three hundred years before the first European settlements. On average, a given stand of forest will burn every hundred years, indicating that the climax condition is barely achieved before it is destroyed. Thus, the virgin spruce-fir climax was normally subject to frequent catastrophic destruction, which continually maintained some fraction of the vegetation in the process of succession.

Albert Swain, a colleague of Heinselman's, has extended this fire history an additional 1,000 years into the past by analyzing sediment cores from Lake of the Clouds, situated in the center of the virgin forest. Each year, this lake lays down a distinguishable layer of bottom mud consisting of sediments and pollen carried in from the surrounding drainage basin. By identifying charcoal bands and jack pine pollen, Swain dated the major fires in the vicinity. For any forest stand, he found the average frequency of burning was sixty to seventy years. The cores also contain charcoal deposits and a high abundance of jack pine pollen throughout the historical record.

Fire, and the consequent destruction and succession of plant communities, appears to be a recurrent and natural event in these forests. Historically, the major burnings coincide with years of summer drought and are probably ignited by lightning. In addition to maintaining species diversity, frequent fires recycle mineral nutrients tied up in plant tissue and prevent the accumulation of highly flammable brushwood and dead timber, which support massive, uncontrollable conflagrations. A policy of fire suppression could be causing permanent and unpredictable changes in the natural vegetation of wilderness areas.

Fire is not the only kind of disturbance. John Henry and Mark Swann, working at the Harvard Forest, have published an equally meticulous historical reconstruction of virgin Pisgah Forest in southwestern New Hampshire back to A.D. 1665. By coring living and dead trees and carefully dissecting soil layers for evidence of dead trees and fire, these workers found a recurrent pattern of violent disturbance that prevented any orderly succession. In 1665, the vegetation was completely destroyed by a catastrophic fire, which the authors speculate may have been fueled by the many dead, dry trees blown down by a hurricane that passed through the area in 1635. During the following 270 years, three violent windstorms, in 1898, 1909, and 1921, interrupted the development of a forest of hemlock and white pine and brought down nearly half the trees. Finally, the Great Hurricane of 1938 swept through central New England and destroyed the entire forest, leaving a crisscross lattice of uprooted trunks. Today these ghosts of former trees, each with a jagged web of roots radiating from its base, lie in decay beneath layers of moss and fallen litter. In the wake of the hurricane's destruction, a new forest completely different in composition began to develop from saplings that had survived the winds and from seedlings able to germinate and grow in the open pits of raw soil. Henry and Swann found little evidence for any process of orderly succession and concluded that the composition of the forest was largely determined by the history of disturbance.

The behavior of each species in Pisgah Forest is illuminating. White pine seedlings, for instance, colonized the ash layer only after the severe fire of 1665 and only until 1687. Hemlock also invaded after the 1665 burning but continued to establish plants until 1780. No new hemlock seedlings appeared until the windstorms about the beginning of the twentieth century. Black birch and red maple were absent from the forest until the major tree blowdowns of 1921 and 1938. Black birch appears particularly adapted to the raw soil clinging to the upturned roots of trees, while red maple prefers the damper pits of accumulating litter beneath. The establishment of these

FREE-EXAMINATION FORM

SONGBIRDS OF THE WORLD

Valid only if postmarked by April 30, 1981.

The Franklin Gallery
Franklin Center, Pennsylvania 19091

Please send me *The Baltimore Oriole* framed color engraving *free* for 15 days. If I decide not to keep it, I will return it within that time and be under no obligation. Otherwise, I will receive a new framed color engraving each month until the series of eight songbirds is completed. I prefer to pay as follows:

☐ Bill me $29.* for each color engraving with shipment.
☐ Charge my credit card at $29.* for each color engraving, after its shipment (check one):
( ) American Express ( ) Diners Club ( ) Master Charge ( ) VISA

Account No. _____

Expires _____/_____ **Plus my state sales tax and $1.50 for shipping and handling.*

Signature _____
ALL APPLICATIONS ARE SUBJECT TO ACCEPTANCE

Mr./Mrs./Miss _____
PLEASE PRINT CLEARLY

Address _____

City, State, Zip _____

Natural History

© 1981 FG

Limit: One subscription per person.



NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

WI

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO. 1 FRANKLIN CENTER, PENNSYLVANIA

POSTAGE WILL BE PAID BY ADDRESSEE

THE FRANKLIN GALLERY
Franklin Center, Pennsylvania 19063

A collection of limited edition bird engravings . . . try the first one in your home free for 15 days

Songbirds of the World

ENGRAVINGS

Beautify your home with these original color engravings.

Each one matted in silk and framed for immediate display.

And available to you at the very attractive price of just $29 each.



THE BALTIMORE ORIOLE. Framed engraving shown smaller than actual size of 11¾" x 8¾"

When a renowned nature artist and a master engraver combine their talents, the result is sheer magic! And there is magic in the original color engravings that comprise this unique collection. Eight of the world's most beautiful and delightful songbirds are interpreted in art by the famed ornithological artist Robin Hill and the distinguished engraver Yves Beaujard.

Created in the tradition of John James Audubon, these new color engravings are not only works of art—they are also a lovely enhancement for your home. And you will be able to display each one the moment it arrives—because it will be sent to you *matted in silk and framed*. Moreover, you can examine the first engraving—*The Baltimore Oriole*—free for 15 days.

Realistic art—masterful engraving

A perfectionist in every sense, Robin Hill produced dozens of sketches of each bird from every angle. Next he refined his sketches, over and over again, before creating the final art. Hill has meticulously portrayed every detail, every feature of the birds—and has paid careful attention to re-creating their magnificent colors. The brilliant black and orange of *The Baltimore Oriole*, the rich blue of *The Indigo Bunting*, the marvelous tones of *The European Goldfinch*, *The Rufous Whistler*, *The Linnet*, *The Long-tailed Rosefinch*, *The Multicolored Tanager* and *The Diamond Firetail*.

Engraver Yves Beaujard then took the artist's original works and *hand-engraved* the master plate for each—making sure to capture every element and every subtle nuance of the artist's work.

This method of working—the artist and engraver together—is all but a lost art in our day. Yet the result is well worth the effort. For the final engravings are works of stunning beauty. And they are unusual—because hand-engraving adds a crispness of line and detail that other art forms rarely achieve.

A limited edition at an uncommon price

"Songbirds of the World" will be issued in limited edition—available *only* during this year. After that, the collection will never be produced again. Furthermore, it can be acquired *only* from The Franklin Gallery. Since the engravings are being issued directly by the Gallery and not through dealers, they can be offered at just $29 each—a very reasonable price for silk-matted, framed color engravings.

And, you have the privilege of trying the first engraving in your home for 15 days *free*. During that time, hang it in your living room, den or bedroom and see how it adds color and beauty to any room. Then, if you decide not to keep it, you may return it within 15 days and be under no obligation.



Each engraving is framed for convenient wall display. And each is fitted with an easel back so that it may be placed on a table, buffet or dresser if desired.

To receive your first engraving on this special free-examination basis, be sure to mail the application below to The Franklin Gallery, Franklin Center, Pa. 19091, by the advance subscription deadline of April 30, 1981.

FREE-EXAMINATION FORM

SONGBIRDS OF THE WORLD

Valid only if postmarked by April 30, 1981.

The Franklin Gallery
Franklin Center, Pennsylvania 19091

Please send me *The Baltimore Oriole* framed color engraving *free* for 15 days. If I decide not to keep it, I will return it within that time and be under no obligation. Otherwise, I will receive a new framed color engraving each month until the series of 8 songbirds is completed. I prefer to pay as follows:

( ) Bill me $29.* for each color engraving with shipment.

( ) Charge my credit card at $29.* for each color engraving, after its shipment (check one)
( ) American Express ( ) Diners Club
( ) Master Charge ( ) VISA

Account No. _____

Expires _____

*Plus my state sales tax and $1.50 for shipping and handling

Signature _____
ALL APPLICATIONS ARE SUBJECT TO ACCEPTANCE

Mr
Mrs
Miss

PLEASE PRINT CLEARLY

Address _____

City _____

State, Zip _____

Limit: One subscription per person.

The World's Most Comfortable Shoe!

The Famous CosmoPedic™

Not $50 Not $25

Here Only $14.99



Genuine Leather
Smooth or Sueded

TRY THEM AT OUR RISK!
Return Within 14 Days for Money Back

NOW! BLISSFUL COMFORT MORNING TO NIGHT! The closest thing to going barefoot! Handsomely-styled CosmoPedic shoes are the ultimate in comfort . . . and quality-crafted with features you'd expect to find in a $50 or $25 shoe! Luxurious genuine leather uppers in deer-tanned smooth or sueded leather are incredibly soft, yet amazingly shape-holding. The unique CosmoPedic arch support assures comfort thru long hours of standing or walking. A stitched collar prevents annoying chafing around the ankles. And for that walking-on-air feeling . . . cushioned insoles and crepe soles pamper your feet from heel to toe! In Tan or Black smooth leather; Brown or Sand sueded leather . . . just $14.99!

for Men and Women

Men's ½ sizes: 7 to 12, also 13
Width: C, D, E, EE, EEE
Women's ½ sizes: 5 to 10, also 11
Width: B, C, D, E, EE, EEE

Old Village Shop Hanover, PA 17331

SATISFACTION GUARANTEED OR MONEY BACK

OLD VILLAGE SHOP, Dept. VM-3370, 340 Poplar Street, Hanover, PA 17331

Sure, I'll try the world's most comfortable shoes. Please send me:

___prs. Men's Tan Leather (M242578B) Size/Width___
___prs. Men's Black Leather (M236802B) Size/Width___
___prs. Men's Brown Sueded (M242586B) Size/Width___
___prs. Women's Tan Leather (M203562B) Size/Width___
___prs. Women's Black Leather (M203687B) Size/Width___
___prs. Women's Brown Sueded (M223784B) Size/Width___

for just $14.99 pr., plus $2.90 per pr. postage and handling.
SAVE MORE! Order Two pair for just $28.99 plus $5.00 postage and handling.

CHARGE IT: ☐ VISA ☐ Diners' Club ☐ Carte Blanche ☐ American Express ☐ Master Charge
☐ Enclosed is $_____
Acct. #_____ Exp. Date_____
PRINT NAME_____
ADDRESS_____
CITY_____ STATE_____ ZIP_____

We ship within 48 hours; delays notified promptly. Delivery guaranteed within 60 days.

© Old Village Shop 1981



Support your tomatoes in style. Top grade Eastern Spruce is cleverly notched to slide together. Full 48" high for your tallest plants to rest on cross beams with minimal tying. Ours exclusively. Set of two 9.75; six 24.75; twelve 41.00. Postpaid.

GARDENER'S EDEN Send for free catalog of unique gardening accessories.

25 Huntington at Copley Square, Dept. C5, Boston, MA 02116. 617-236-1884
Check, Master Charge, Visa. Mass. residents add 5% tax.

LYNCHBURG HARDWARE & GENERAL STORE

65 Main St., Lynchburg, TN 37352



JACK DANIEL SQUARE GLASS SET

Mr. Jack Daniel was the originator of the square bottle for his whiskey and always wanted to have a matching square glass. Well, here it is! This hefty square glass (each weighs 14 ounces) is the perfect companion to a bottle of Mr. Jack's finest. The inside is rounded to make drinking a pleasure and the original design is fired on for good looks and durability. My $15.00 price for a set of 4 glasses (8 oz. capacity) includes postage.

Send check, money order, or use American Express, Visa or Master Charge, including all numbers and signature.

(Tennessee residents add 6% sales tax.) For a color catalog full of old Tennessee items and Jack Daniel's memorabilia, send $1.00 to above address.

trees apparently required catastrophic disturbance of the previous vegetation by hurricane. Beech also displays a most intriguing pattern of establishment. No seedlings appeared until 1810, when the oldest white pines were 155 years old. Thereafter, a successful beech seedling appeared roughly every ten years, arriving, not as a result of major storms, but through some conjunction of unknown events. Thus, what spells destruction for one species leads to the accession of another; disturbance lies in the eye of the beholder.

Disturbance may also take the form of biological forces, such as disease, which can be especially disastrous to plant communities because their effects can multiply in time, and grazers. Heinselman noted that mature stands of balsam fir are particularly susceptible to outbreaks of spruce budworm, which devastate many acres and create fuel for fire. On the prairies, the annual migration of buffaloes undoubtedly had an immense impact on the vegetation. Some herds numbered four million, and their passage must have left a swath of deeply cut sod, with local patches of packed grass and manure in the vicinity of large congregations.

The scale of disturbance need not be vast and catastrophic. William Platt, a plant ecologist working in virgin prairie in Iowa, identified a community of plants that grow on mounds of soil created by badgers digging for ground squirrels. These herbaceous perennials—showy goldenrod, false boneset, common milkweed, and lobed cudweed—flourish on badger diggings but are relatively rare in the surrounding prairie. They appear well adapted to this transient habitat: all grow rapidly and produce early and abundant seed capable of colonizing other local disturbances. Thus, even the modest scratchings of a mouse may provide sufficient space in a sward of white clover for a ragweed seedling to escape from the shade of established vegetation.

Once we shift our perception of disturbance from the scale of the plant community to the death of the individual plant, disturbance is ubiquitous in all natural communities. A devastating hurricane lethal to hemlocks leaves young maples untouched and lays a seedbed for black birch. A local rabbit warren brings a palatable grass to the brink of extinction, but the adjacent brier patch thrives. Disturbance

does destroy life, and in this capacity we can define it as an unexpected increase in the probability of dying. But it is also intimately associated with the establishment of new individuals. Destructive action creates space where there was none before, and in nature no space lies vacant for long. There are always species with subtle adaptations for recognizing those conditions favoring growth into the canopy foliage.

Just how subtle these adaptations may be has been demonstrated by John Harper and his students at University College of North Wales, who term such local disturbances safesites for seedlings. These investigators laid down a uniform garden seedbed in which they sowed seeds of three related species of plantains—the great, the ribwort, and the hoary plantain—over the moist soil surface. To create microsite disturbances, they dug holes to different depths in the soil or left small, wooden boxes with their sides partly projecting above the surface or laid sheets of glass flat over the seeds. Two months of germination revealed obvious differences among the species. Few seedlings were found in control sites without any soil disturbance. The hoary plantain germinated vigorously under glass, probably because of the warmer temperatures and intense moisture. The great plantain was somewhat uncooperative, preferring to appear in locations just outside the local disturbances. The ribwort plantain favored boxes and deep holes. Most remarkable were two large clusters of ribwort seedlings vigorously sprouting from a pair of earthworm casts left at the surface. Undoubtedly all these objects mimic the kind of natural microsite disturbances that favor the establishment of new individuals, and each species is adapted to slightly different circumstances.

This view of disturbance, scaled to relate to the biology of particular species, is a very different interpretation of nature from Clements's view of stable, permanent climax vegetation. Sudden and unpredictable upheavals are prevalent in nature, and the deaths of some individuals are soon followed by the establishment of others. From the perspective of the individual plant, the world appears closer to Turner's vision.

Robert E. Cook is associate professor of biology at Harvard University.

The new Peterson field guide to everyone's favorite subject!

Clouds • storms • false suns • particles • and more, identified and explained for the amateur. Can be used anywhere on earth — and beyond!
32 color photos • 337 black & white photos • 53 line drawings • 384 pages
PLUS: experiments to perform at home
$13.95, now at your bookstore

Houghton Mifflin Company
2 Park St., Boston, Mass. 02107

A FIELD GUIDE TO THE
ATMOSPHERE
by Vincent J. Schaefer & John A. Day

Marcia Ascher and Robert Ascher

CODE OF THE
QUIPU
A Study in Media, Mathematics, and Culture

At the height of their civilization the Incas had no system of writing, but instead used quipus — colored cords, knotted in a special manner — to record and transmit information. Based on a study of quipus found in Inca graves during 19th- and 20th-century excavations, *Code of the Quipu* presents a fascinating anthropological and mathematical study of the problem of interpreting artifacts from a distant culture.
$18.95 / paper **$8.95**

The University of Michigan Press
Dept. AB P.O. Box 1104
Ann Arbor, MI 48106



Enter the world of Questers nature tours.

When you travel with Questers, you have the advantage of our knowledge of the travel world. And our experience of the natural world. We are travel professionals. And our only tour program is Worldwide Nature Tours.

Under the leadership of an accompanying naturalist, we search out the plants and animals, birds and flowers ... rain forests, mountains, and tundra ... seashores, lakes, and swamps of the regions we explore. At the same time, we include the more usual attractions in touring—the cities, archaeological sites, and people.

The current Directory of Worldwide Nature Tours describes 29 tours varying from 9 to 36 days and going to virtually every part of the world. Included are The Amazon, Peru, Patagonia, Galapagos, Hawaii, Alaska, Death Valley, Everglades, Ladakh, Sri Lanka, Iceland, Scotland, Greece, Australia, and New Zealand. Tour parties are small, the pace leisurely, and itineraries unusual.

Call or write Questers or see your Travel Agent today for your free copy of the Directory of Worldwide Nature Tours.



QUESTERS
Questers Tours & Travel, Inc.
Dept. NH 481, 257 Park Avenue South
New York, N.Y. 10010 • (212) 673-3120

The African Elephant's Drinking Problem

On the way to the river that is their main source of water, elephants raid crops. Local farmers complain, but ivory hunters are making a killing

by James Allaway

On its meandering journey through the bushland of eastern Kenya, the Tana River—Kenya's longest—has carved a shallow trough in the semiarid plains. The river is virtually the only permanent surface water in this periodically desiccated region, and vegetation grows more richly here. What happens on the river's narrow flood plain is crucial to the region's human population and herds of elephants.

Of all Africa's wildlife, elephants have perhaps the greatest ecological impact and most marked interactions with people. Elephants can greatly affect the structure and species composition of vegetation, thereby influencing the habitats of other wild animals, domestic livestock, and people. They can be significant conduits of nutrient and energy flows. Elephants are also a major tourist attraction, often damage farm crops, and their ivory has for centuries been one of the most highly valued and violently contested products of the continent.

Harsh and mostly undeveloped, the lower Tana region has long been a stronghold of elephants. In recent years it has increasingly come to be a focus for agricultural, ranching, water-resources, and tourism development. Through a study of how elephants use the area and interact with people, carried out in cooperation with the then Game Department of Kenya, I hoped to provide part of the ecological understanding needed to guide the dramatic changes in land use coming to the region. The key elements were the elephants' seasonal patterns of movement and habitat use and their two principal conflicts with people: elephants' raiding of farms along the river and the widespread illegal hunting of elephants.

For much of the 300 miles of the Tana's lower course, its flood plain varies from a few hundred feet to a couple of miles in width; below the village of Wenje, 57 miles from the coast, it gradually widens into a broad delta extending to the Indian Ocean. Central in the flood plain's importance to elephants is the flux of the equatorial seasons, marked by the sun's semiannual north–south passage. Shifts in the prevailing monsoon winds bring two rainy seasons to the lower Tana, interspersed with extended dry periods. The river, fed by rainfall on the Aberdare Mountains, Mount Kenya, and other uplands of central Kenya, usually floods twice a year. The floods are unpredictable in their magnitude and timing, however, and storms within the region are often localized. Thus the elephants, other wildlife, and people must cope with an environment alternately wet and dry—and often unpredictably so.

Elephants cope by moving over vast areas of the interior—perhaps 15,000 square miles on the west side of the river—when water is available there and falling back on the permanent supply of the Tana River as the interior dries up. This kind of seasonal movement, called a dispersal/concentration pattern, is typical of many water-dependent mammals, including traditional pastoralists and hunters.

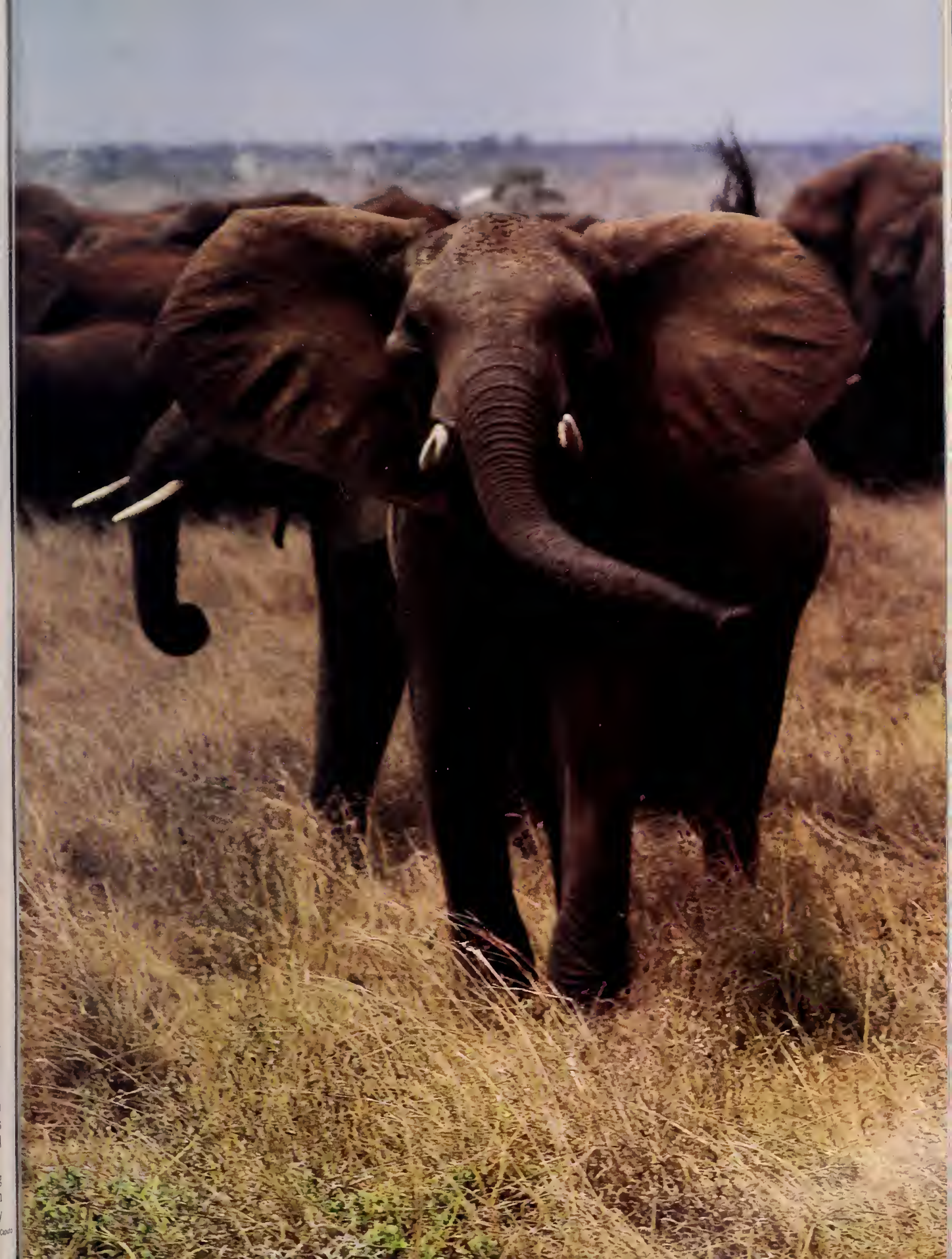
During a rainy season and for several weeks afterward, elephants roam over large areas, drinking from the countless shallow depressions and larger rain pans. New grass shoots, herbs, and bushes and trees lush with new leaves provide abundant food. Then, as sun, wind, and drinking by elephants, cattle, and other animals drain the rain pans, the elephants begin to pull back toward the Tana and its flood plain.

Most basically, the river provides elephants with drinking water. In dry months, however, the river is not accessible along all its banks. Banks are commonly six to ten feet high, and only slope gently enough for elephants to clamber up and down at scattered sites, mostly at the inside of a meander curve or the mouth of an oxbow. This restriction on elephant drinking influences which areas they travel through, feed in, and encounter people.

During dry times the flood plain and nearby areas must also supply the prodigious quantities of plant materials elephants eat. Flood-plain vegetation is an intricate mosaic, shaped by past changes in the river's course, underlying soil conditions, and cutting and burning by people of the Pokomo, the Orma, and related tribes. Patches of forest often occur on higher sites, dense spiny thickets and herbaceous plants in low backwater areas, grasslands on middle elevation flats, and banana plantations or fields of other crops near the river. The complexity is increased by the various stages of regenerating forest and bushland growing on abandoned farm fields and former river channels. Thus the flood plain provides a variety of habitats to feed in, and the elephants use all of them.

Elephants do not limit their feeding to the flood plain, however, even when the only drinking water is there. My

Bob Caputo



observations on the ground and during aerial surveys confirm that in the dry seasons the elephants at times travel and feed far inland, as has been reported for elephants in similar environments elsewhere. Typically, as a dry season progresses, elephants feed increasingly on flood-plain vegetation, and by late in the season, particularly when the drought is severe, this is a heavily used food source.

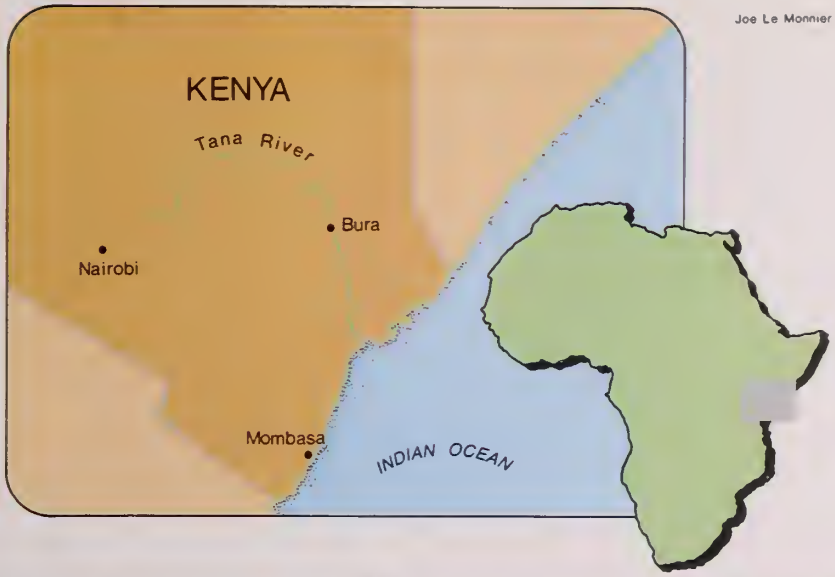
In addition to food and water, the flood plain provides cover. In cool dark forests and under the shade of scattered trees, elephants find protection from the baking midday sun. They also find refuge from human disturbance deep in dense woodlands or thickets. Elephants rarely stay in the open or near well-traveled human paths during the day.

As elephants concentrate near the flood plain they often raid farms for banana, maize, bean, mango, and other crop plants. They raid almost exclusively at night, usually in the small groups in which they generally travel. They may be turned back by a single-strand fence of vines or barbed wire hung with clattering pieces of metal at the edge of the farm, or they may be repulsed by the farmer and his family shouting, banging on pots, and lighting fires. If, on the other hand, elephants slip into the fields undetected or refuse to be evicted, they can do tremendous damage.

The amount of damage varies greatly. Much depends on the severity of the dry season, the location of the farm (for example, farms near major drinking sites are exposed to more danger), and the farm's defenses. Some seasons, parts of the region have few elephants and farms suffer little; elsewhere damage can range from negligible to total destruction of a crop.

Elephants, along with buffaloes, baboons, waterbucks, and other wild animals, have probably raided farm crops since the animals and farmers first occupied the Tana flood plain together. Damage by wildlife—other species may be as destructive as elephants—often depresses a farmer's crop yield, sometimes disastrously. But wildlife impacts seem to be a secondary influence superimposed on the basic level of production made possible in a particular season by rainfall and floods. If the floods are too low or too brief, crops won't get enough water; if the floods are too high or





Joe Le Monnier

During dry seasons, elephants depend heavily on the Tana River for drinking water. Not all sections of the river are accessible to the elephants, however, as banks are commonly six to ten feet high. Sloping banks, lower left, are situated at scattered sites, and the elephants make extensive use of them to get to the river. Farms located along the paths leading to such drinking sites suffer the most damage from elephants raiding crops. Pastoralists of the lower Tana River also depend greatly on the flood plain when the region dries up because of a lack of rainfall. The river's course, below, is constantly changing, resulting in a mosaic of wet and dry habitats.

Wolfgang Bayer



James Allaway



peak more times than expected, crops drown or wash away. However, the impact of wildlife damage is often magnified since the worst damage tends to occur at just those times when farmers have the fewest reserves to fall back on—late in long, dry periods when crops have been poor.

Conversely, the main direct impact people have on the elephants is killing them. This killing is also often concentrated near the flood plain. Tana elephants have long been hunted for ivory and, to a much lesser extent, for meat. The British colonial government about the turn of the century found a thriving and well-established ivory trade, which has continued to the present. More recently, the Tana was renowned as a prime region for sport trophy elephant hunting, until the nationwide ban imposed on such hunting in 1973.

In the early 1970s, however, elephant hunting escalated with a ten- to fifteen-fold leap in ivory prices from the fifteen to twenty shillings per pound level that had held for decades. (World ivory prices held relatively steady through the mid-1970s but jumped significantly again in 1978.) The style and the impact of hunting changed. Large, well-armed, and well-supplied bands of hunters, many from outside the region, joined the traditional long-bow and poisoned arrow hunters. A factor contributing further to the heavy impact of recent hunting may have been the dry weather during much of the early and mid-1970s, which forced the elephants to spend much time near the river.

How many elephants actually have been killed cannot be known, but by the time of my study (1974–76) the number was already high. In 1976 a ground census of carcasses in a sample area on, and adjacent to, the flood plain found very high recent mortality and much evidence of hunting. The results corroborated other observations and reports on the extent of hunting elsewhere in the region. All strongly indicated that far more elephants were being killed than reproduction could replace.

The elephants are also being affected by change in the native vegetation of the region. Woodlands, thickets, regenerating stands, and especially mature forests—apparently the vegetation types most valuable to elephants—provide quantity and variety of food and also cover. (The scattered patches of mature forest are also essential habitat for other wildlife, including the Tana's two rare monkey species, the Tana mangebey and the red colobus.) But aerial photographs show that during the period from 1960 to 1975, forests on much of the lower Tana flood plain disappeared at an average rate of 1½ to 2½ percent per year. Clearing for farms is thought to be the principal cause. Unlike the situation in some other parts of Africa, elephants in the Tana region did not appear to be doing significant damage to the overall status of the vegetation.

Certain flood-plain resources that elephants need are relatively scarce, particularly safe drinking sites, mature forests, and refuges secure from disturbance.These are likely to become scarcer still, as human land use expands and intensifies. Access to drinking sites may be cut off by new farms and expanding villages; forests and regenerating woodlands may be cleared for farms, selectively cut for dugout canoes and building poles, and scorched by fires; refuges may be penetrated by hunters and exposed to generally increased human activity.

More drastic alterations to the Tana region's natural conditions and processes may result from major economic development activities under way. Some analysts think hydroelectric power generation dams and water-supply reservoirs upstream (some in operation for several years) may change flood patterns and low-water levels. If this happens, the present dynamic character of the river could be tamed, and everything that has evolved with, or adapted to, the river and its flood plain could be affected—forests and grasslands, elephants and monkeys, farmers and pastoralists.

A more immediate impact on elephants will result from the large irrigation project being built near Bura, in the middle of the region. Elephants will lose not only the project area (just off the flood plain) but, more important, possibly the flood plain behind it, as well as the whole area between the river and the planned main canal supplying irrigation water from many miles upriver. The canal is designed to permit crossings by elephants, and water holes are being constructed in the hope of satisfying the animals outside the project. Whether these efforts will succeed is not certain. Considering the importance of flood-plain vegetation to elephants and the frequent aridity of the Bura region, a reduction in elephant numbers in the vicinity seems a likely result of the reduction in flood-plain resources. The vast increase in human activity accompanying the scheme (it is projected to support a population nearly equal to the entire region's present population) is likely to have severe and even broader repercussions. Furthermore, some observers fear there will be effects on the river from offtakes of water for irrigation and from saline or chemically polluted discharges back into it.

Our understanding of elephants, traditional human land use, and other aspects of natural ecological systems in the Tana region is only sketchy. But some basic facts and principles are known that can help guide future management of natural resources, whether the objective is to protect elephants and forests or to assist farmers and pastoralists. The Tana region until very recently was little altered by development. Now change is coming, and anticipating and controlling its impact can be aided by understanding how natural systems worked in the past and seeing just what is at stake. For elephants, for other wildlife, and for people—for everything that depends on the present character of the flood plain—much is at stake.

Good seasonal rains have fallen on the Tana region most years since my field research. But as the inevitable, extended dry periods recur, the elephants that remain must return to the river. Again the flood plain's water and vegetation will become paramount in their existence. Conflicts with people can be expected to intensify as human use of land increases and the price of ivory continues to rise. The elephant's prospects are uncertain. □



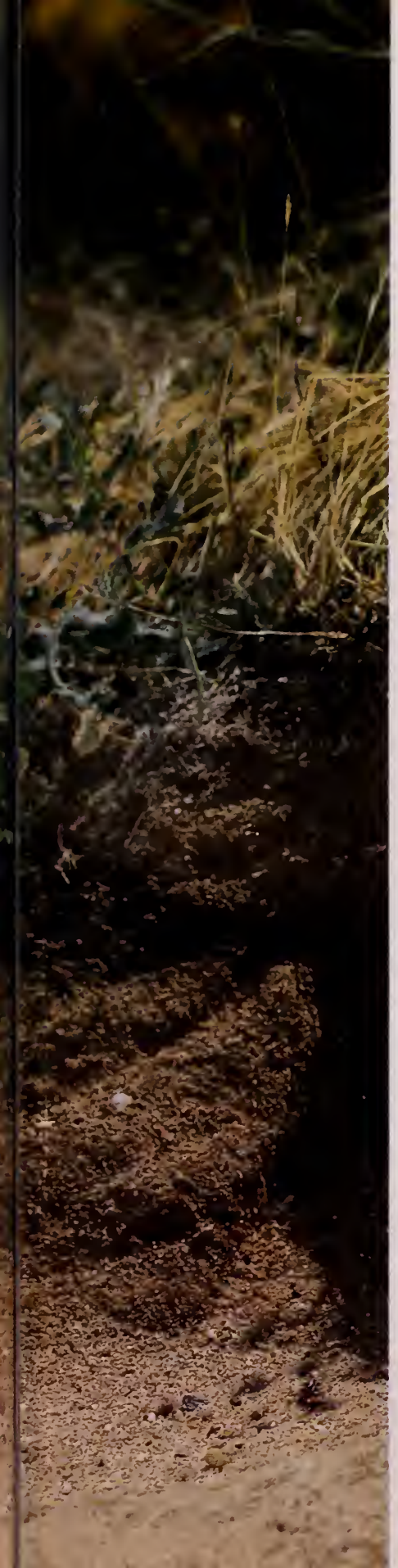
Bob Caputo

The 1,500 percent increase in the price of ivory during the past decade has led to the massacre of elephants throughout Africa. Hunting elephants for their ivory has a long history in the Tana River region; high prices, the use of modern weapons, and poaching raids by Somali tribesmen have accelerated the slaughter. The huge animals make easy targets, particularly when they are concentrated on the Tana River flood plain during the dry season. Hunters typically hack the tusks out of the elephant's skull, left, leaving the rest of the body for scavengers or simply to rot.

Wolfgang Bayer







Bees for the Birds

photographs by Javier Echevarri and Mila Olano

The European bee eater, *Merops apiaster*, belongs to an Old World family of brightly colored, insectivorous birds. Many of the insects bee eaters catch—bees and wasps primarily—are venomous, and all species are adapted, in behavior and morphology, to their hazardous prey. The birds' long, pointed wings fit them for twisting flight, while their long, inflexible bill, decurved to a sharp point, is useful in catching stinging insects.

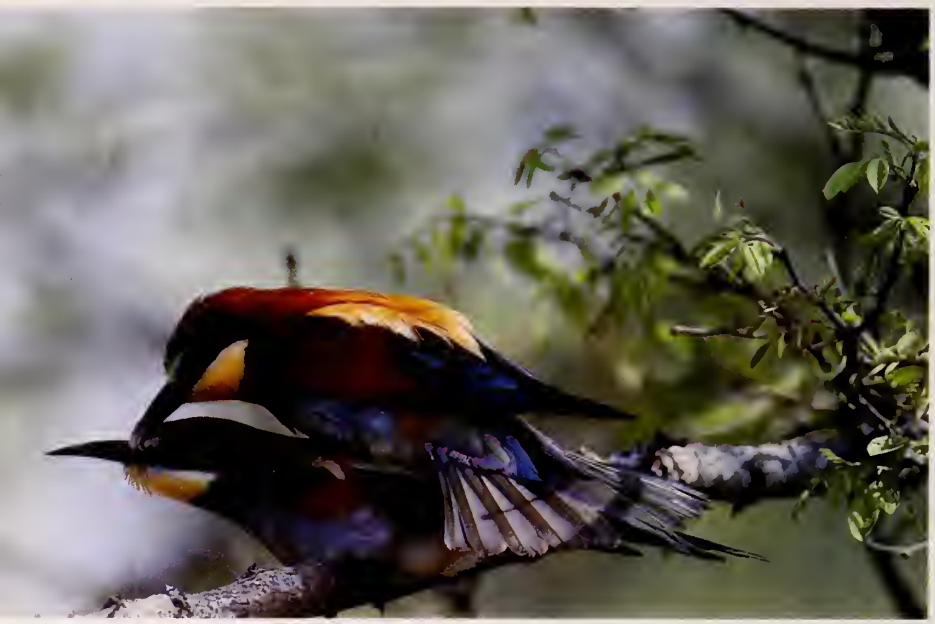
Bee eaters hunt while in flight or in dashes from a perch, usually a tree branch or telegraph wire. Large species, such as the eleven-inch-long *Merops apiaster*, may hunt from as high as 300 feet and sometimes feed in flight, mostly on soft-bodied, nonvenomous insects. Before eating venomous prey, however, the bee eater returns to a perch to remove the poison. After manipulating its catch into a good working position, the bird raps the insect's head sharply on the perch; then, altering its grip, it rubs the insect's abdomen on the perch to force the venom out. The bird can then safely eat the insect or deliver it to the young waiting in the nest (below).

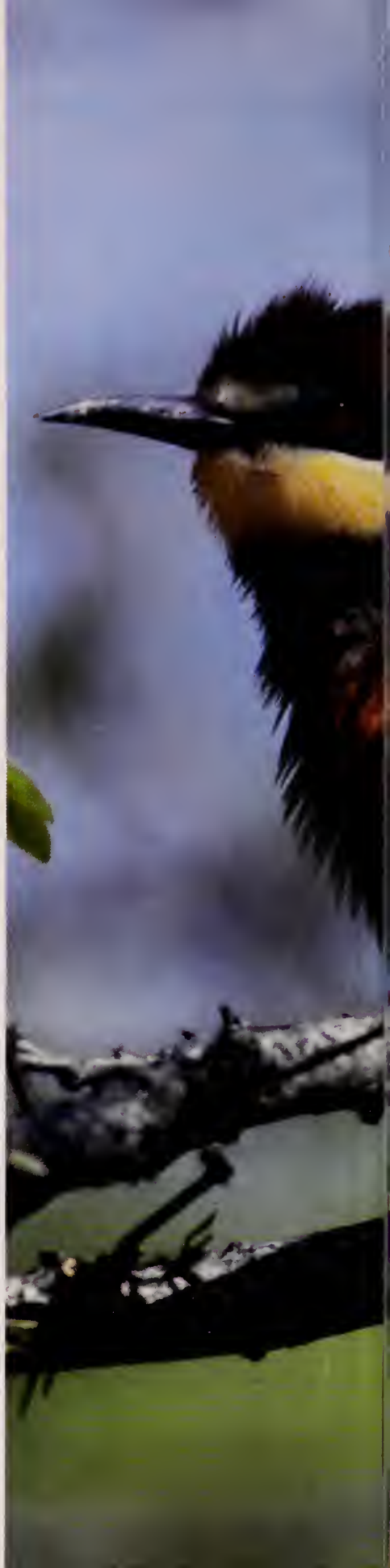
All bee eaters are single brooded and nest in burrows, excavated most often in a bank or cliff, occasionally in level ground. *Merops apiaster* breeds from western Siberia and Kashmir to North Africa and the Iberian Peninsula, where these photographs were taken. It generally nests in dense colonies; sometimes, however, only a few pairs are seen nesting in an area.

After arriving from their wintering grounds in tropical and southern Africa and northwestern India, a breeding pair of European bee eaters choose a nest site and begin to excavate. They loosen the soil with their bills, then use their









legs to kick it out of the tunnel. In this manner, they dig a more or less horizontal burrow, usually several feet long, with an unlined nesting chamber at the end.

Courtship among European bee eaters is straightforward. After assuming a precopulatory upright stance, they may perform ritualized gestures. One bird may bow its head several times, as if it were rapping an insect against the perch, its bill almost striking the perch near the feet of the other bird. Copulation (above) is also often preceded by courtship feeding.

Both male and female incubate the eggs and care for the young. They never clean the nest, so the chamber eventually is cluttered with regurgitated pellets of indigestible matter, primarily sclerites, and the walls become coated with dried feces.

Toward the end of the breeding season, the accumulation of filth in the burrows and, in dense colonies, the congestion of the population result in ectoparasitic infestations. Bee eaters engage in a variety of sun- and dust-bathing postures, partly to relieve their lousiness. One sunning position, common to all bee eaters, involves perching with the mantle feathers fluffed up (right) to expose the skin to the sun's rays.

Rebecca B. Finnell







Street Urchins of Colombia

Amid the poverty of overpopulated cities, thousands of young children learn to survive through their own ingenuity

by Kirk Felsman
photographs by Anthony Boccaccio

The streets of major cities have always served as both theater and battleground for the children of the poor. Nowhere is this more apparent than in present-day Colombia, where thousands of street children, so-called gamins, struggle to survive with little or no support from the traditional institutions of family, church, school, or state. Young ragamuffins, darting in and out of traffic, begging in open-air restaurants, singing for change on city buses, bathing in public fountains, or simply curled up asleep together, sometimes along with stray dogs, are all too common sights. The street urchin has become so much a part of Colombian society that a recent performance of the National Ballet Company included a piece entitled *Gamin*, while a popular soap opera on the same subject is broadcast most evenings in the capital city of Bogotá.

The word *gamin* comes from the French, meaning "urchin." It is but one of the by now pejorative names these children have long endured. One can also hear *chinos de la calle* ("children of the street," from the Quechua *chino*, "child") and *chinches* ("bedbugs"), used to refer to the smallest waifs, as young as age five. The children naturally seek to be recognized and known as individuals, preferring their own names and nicknames. But they also find strength in a shared identity. For a collective name, most prefer to be known by some variation of *muchachos* ("boys") *de la calle* or *niños* ("children") *de la calle*.

Street children are not unique to Colombia. Major cities in Brazil, Mexico, Turkey, India, and other countries face like problems on a similar scale. For historical comparison, one recalls the *scugnizzi* ("spinning tops") of Naples and the Barnardo Homes of England, as well as the often described vagrant children in late-nineteenth- and early-twentieth-century Russia and France. The portraits offered up in Dickens's *Oliver Twist*, Morris West's *Children of the Sun*, or Luis Buñuel's film *Los Olvidados* (*The Forgotten Ones*) all evoke common themes. And one of the most serious problems with street children existed in the United States. In 1852, police records estimated there were 10,000 vagrant children adrift in New York City, and similar problems existed in Boston and Chicago. During the period of tremendous immigration and industrialization these waifs were popularly known as "street Arabs." At the turn of the century, the writer, photographer, and reformer Jacob Riis graphically portrayed the lives of these children in his book *How the Other Half Lives*.

Gaminismo, as it has been called in Colombia, is an urban phenomenon linked to the tremendous rural-to-urban migration that has changed the face of Latin America during the past

A storefront alcove in Bogotá shelters a camada, *a loose-knit group of children who sleep together for warmth and protection. Although this group includes a girl, most street urchins, or gamins, are male.*

All photographs from Ocelot

Bogotá is noted for its galladas, *groups of about eight to fifteen children in which membership and leadership are fairly rigid. Although not free of violence and exploitation,* galladas *generally offer their members a measure of protection and emotional support. Outsiders commonly regard them as gangs of young thieves, and it is true that crime may be one of their means of survival. Within the* gallada *sharing a marijuana cigarette, below, the boy with close-cropped hair can be recognized as one who was detained by the police not long before. The police shave the heads of those they pick up, ostensibly for reasons of hygiene, but also to aid identification.*



two decades. This migration has been described by urban planner Edward Popko as a hunger-dictated "push" from the country rather than an economic "pull" from the city. Industrialization has not kept pace with this population shift, which has brought little more than a transfer of poverty from rural to urban areas. The forces of modern communication, transportation, and national education have only heightened the effect. In addition, the trend was exaggerated in Colombia owing to *La Violencia*, a period of primarily rural political violence and banditry that has been likened to a civil war. In search of safety, people were forced toward the cities, and those already there were forced to remain. Only Colombia's coastal regions escaped the worst effects of this disruption, which began in 1948 and lasted at least into the 1960s.

With some 5,000 street children—there are no reliable statistics—Bogotá has been called the capital of the abandoned child. The phenomenon is equally significant in Cali, Colombia's third largest city, where the estimated numbers run to over 1,000. Cali's warmer and drier climate is more hospitable, and it is not uncommon to find children who have traveled hundreds of miles from Bogotá, seeking the milder weather. A sampling of street children in Cali reflects, more accurately than a sampling from Bogotá, Colombia's great racial diversity and dispels the popular myth that only mestizo children (those of mixed Spanish-Indian descent) become gamins. Cali is the nation's fastest-growing city, exemplifying the population pressure and poverty that contribute to *gaminismo*. With a population of little more than 100,000 in the 1950s, Cali has expanded to well over a million people. Migration accounts for most of this increase, and the swelling of slums has placed an unbearable burden on the city's limited public works and social services. Despite an alarming infant mortality rate (92 of every 1,000 babies die in the first year of life, in contrast to 16 per 1,000 in New York City), more than half of Cali's population is under eighteen years of age.

Street children do not all share the same plight, but fall into three general types. The first and largest category consists of those children who maintain some family connection although

Gamins often bear the scars of earlier abuse as well as those of their rugged street life. Many children who work and beg in the streets maintain some family connections. Others are truly abandoned or have chosen to leave home.



they spend the vast majority of their time in the streets. Some work or beg in pursuit of money or goods to bring home after nightfall. Others return home only around religious holidays or when driven by some impulse to make contact.

Carmen (age 6), Elena (age 5), and María (*la niña*, or "the baby") are sisters who beg together within a circumscribed number of blocks in downtown Cali, appearing at the same open-air restaurant every morning. I was struck from the outset by the contrast between their joyful play among themselves and the sad tale they presented together while "working." Coached by her older sisters, cowering a little, hands outstretched, María was always the first to approach a stranger and begin to tell their story. Over the months, I came to know them—and their mother. She was not in a home for the destitute, where her daughters' story placed her, but only a few blocks away, working as a fruit vendor. Mother and daughters traveled daily from the squatter settlement where they lived to Cali's downtown area. The girls would then leave their mother to beg on their own, but they would check in with her periodically and return home with her at night.

With the exception of such girls, who are under some family supervision, the gamin population is almost wholly male. The careful observer may witness a pair of young girls moving together through the streets, almost identical in mannerism and appearance to their male counterparts, or hear of a particular girl who has become a member of a group of boys. More often, however, a girl who lives independently of her family is drawn instead into organized prostitution, accepting refuge and shelter of the most exploitive kind.

Children who have actually been orphaned or physically abandoned constitute the smallest category of street urchins. The misperception that they are in the majority has been fostered, in part, by superficial writing about street life, based on quick interviews. Gamins often readily describe themselves as orphans, both because good storytelling is basic to successful begging and because denial may be the most effective defense against inner pain and conflict.

The truly abandoned child may frequently be the one the family is least able to care for, perhaps because he suffers from some physical impairment or neurological disorder. Such children are least equipped to face life in the streets, but there are few care facilities that can offer an alternative. There is no doubt that many simply perish.

At age ten, Enrique had been in the streets less than a year when I met him. Originally he attributed his deformed hand and severely scarred arm to a terrible bus accident in which he was injured and both his parents were killed. Later, in a quiet, collected manner, he told his true story. When his family first arrived in Cali, Enrique had accompanied his mother as she begged on the streets. Then, gradually, he had begun to beg alone, returning home each evening—to a piece of canvas stretched over a wooden frame, underneath a city street overpass. "One night I came back, and there was another family there. They said my family left at midday. I don't know where they went. So, now I live with the other boys on the street. But I'm not alone." There had been no bus accident: Enrique's deformed hand was a birth defect; his scar the result of a beating.

A child in the final category exists at the opposite extreme: he is the abandoning, not the abandoned, child. Having opted for a life on the streets, such children have little or no contact with their families. While they interact with the other street children, it is they who are the most noticeable and the most difficult to understand.

Not yet ten, Jorge is a veteran of the streets. He believes his family is still in Buenaventura, Colombia's busy southern port, but has never been back to find out. "There wasn't any food to eat, so somebody had to leave." Over time, more is revealed, and particular scars are related to beatings he received from his stepfather. "At first, if I came home with too little, he made me sleep outside, but later, he started to beat me a lot." Jorge's only attempt to fight back, striking his target with a well-aimed stone, was



his last battle; he was warned never to return. "So I left. What else. . . ."

Countless thousands of children remain at home to endure hardships and abuses that children like Jorge refuse to tolerate. The child who strikes out to shape another kind of life for himself often leaves behind numerous brothers and sisters who do not. A mother may describe such a child as the one who "would never listen," who "always asked too many questions," who "would never do as he was told." In short, he is the troublemaker, a child with a difficult temperament in an intolerable environment. Possibly, he is a family scapegoat, who is constantly being given the message to move on. We tend to regard the abandoning, or runaway, child as troubled, even emotionally disturbed. In the case of these particular children, however, leaving home may be a positive, adaptive move toward physical and psychological health.

Girls rarely fall into this category, perhaps because they are more needed within the family. They are expected to care for younger siblings and perform household chores, whereas a more aggressive, independent role is prescribed for young boys. Moreover, in many family situations, the coming and going of *padrastos* ("stepfathers") places different pressures on the boys: there may be competition over the mother and conflict over power or responsibility within the home.

The three types of street children actually overlap, since the plight of an individual child may undergo change or may reflect a combination of factors. And all types of children interact with one another. Survival in the streets is tied to peer support. Bogotá is especially noted for its *galladas* (literally, "roosts"), which offer their members some protection against the ever present threat of crime and abuse. In these groups, which often consist of eight to fifteen children, there is a clear leadership hierarchy, and membership, loyalty, and territory are constant issues. Outsiders often regard *galladas* as gangs of young thieves. There are, indeed, deeply wounded street children capable of great cruelty and outright criminal behavior. But it is important to realize that street children band together primarily to meet emotional and physical needs.

The highly structured *gallada* is almost absent in Cali, but the *camada*

Left: Gamins bathe in a fountain in downtown Bogotá. The climate of the capital city is not the most hospitable for street children. Situated at an elevation of 9,000 feet, Bogotá is often rainy, with an average daytime temperature of 55 degrees. Some children seek out cities with milder weather, such as Cali. There, a child can get by with less clothing, can sleep with less cover, and will find more open-air restaurants in which to beg for food. Below: Often traveling in pairs, gamins hop onto buses to get around a city. The smaller and weaker children may fall off and be killed in the traffic. Sympathetic bus drivers often allow street children to ride inside, where they beg for small change.





("brood" or "litter") is very common. This is a small group of children who sleep in a common area for warmth and protection, seeking refuge in front of large, well-lit buildings or under the sheltered bays of large movie houses. Membership in such groups is loose and informal, with a particular sleeping spot given up, to be reclaimed later.

While exploitation and violence do occur within groups of street children, the older boys usually watch out for the younger ones. On occasion a boy can be observed awakening early, getting up to replace the ragged covering that has worked itself free from a younger companion's shoulder and then returning to his own spot to curl up among those still asleep. The youngest or the smallest child is often the clown, a comic center of attention.

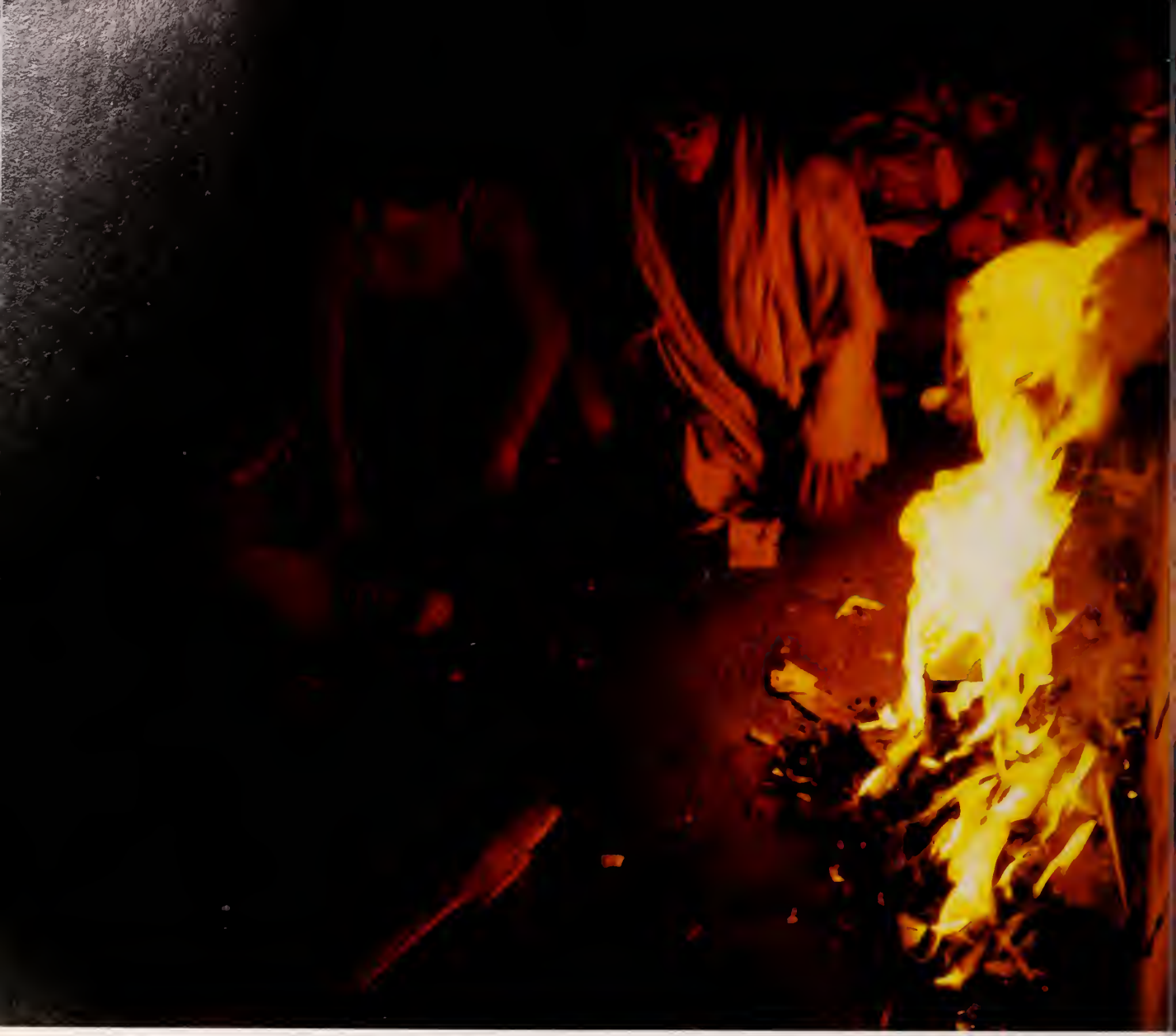
Younger boys typically travel in pairs, bringing to life the "chumship" relationship so well described by the late psychiatrist Harry Stack Sullivan. In what is possibly his first move toward intimacy, a child comes to know himself through another who is similar. Amid the brutality and violence of street life, there exist moments of true warmth, loyalty, and love.

Not all children travel or sleep in groups. There are loners who tend to fend for themselves. Such boys appear tougher, more cautious and aware. For sleeping, they may seek a safer, solitary spot on a rooftop or on the overhang of a building entrance, where they are fully hidden from street view.

Although mistakenly regarded as a separate subculture, the gamins are part of the urban street poor. They are among the thousands of people who labor in the streets at what have been called marginal occupations. Such work ranges from shining shoes and pushing wheelbarrows to raw forms of prostitution, begging, and thievery. The average yield is under three dollars per day, acquired under the worst of conditions. The type of work or "hustle" that occupies these waifs varies with their age and the part of the city they frequent, but is almost always combined with some form of begging.

A main commercial district lined with open-air restaurants and movie houses, such as Cali's Avenida Sexta ("Sixth Avenue"), represents a major resource for the gamin population. Approaches to begging in restaurants differ, and with a drum (a tin can and stick) or mask such requests become performances of sorts. Receiving acknowledgment that a customer's leftovers are free to be taken, the child may eat a single scrap on the spot or quickly scrape the food into a small can or box, generally to be distributed among companions rather than hoarded for later consumption in private. When things are going well in the street, children can become almost particular about what they will eat. Ironically, most gamins appear to be in better general health than their counterparts in the squatter settlements. Where an urchin's physical stature has suffered from serious malnourishment, it is often a mark of earlier years at home, when many siblings competed fiercely for little food.

Begging is common on city buses.



Allowed to crawl under the turnstile by sympathetic drivers, young boys, often in pairs, will move up and down the aisle singing of their plight, sometimes chorusing, "For I am the child of no one." Begging on buses is common for poor adults as well, especially those with an obvious physical handicap. Thus the practice can be highly competitive, requiring both stamina and imagination. The smallest and most animated child is the least likely to ever return empty-handed. His repeated success brings a measure of equality with the older boys. The teen or twelve-year-old urchin must seek out other resources, and petty crime may arise from necessity.

Work takes many forms. In Cali, some waifs assist the estimated five thousand ragpickers who pull their wooden carts through the streets, seeking out anything collectable: cloth, cardboard, glass, plastic, wood. Some capital or backing is required for the shoeshine boys as well as for those who sell gum, cigarettes (individually from the pack), newspapers, or lottery tickets. Other forms of service work include guarding parked cars, rapidly cleaning windshields at a stoplight, or carrying goods in a marketplace.

At the extreme, work becomes crime, and children do become involved in adult-operated traffic in drugs and prostitution. In Cali, the participation in hard crime appears to be on a much less serious scale than in Bogotá. Crime is likely to take the form of purse-snatching or of stripping mirrors and windshield wipers from parked cars.

Marijuana and other drugs are used, more in Bogotá than in Cali. Drug traffic is in general more prevalent in the capital, where there are more street children and their gang life is more highly organized. In Bogotá, the more formidable city in terms of both climate and competition, drugs can provide relief from the pain of cold and hunger, helping to induce much-needed sleep. Tragically, the most common (because it is the most accessible) and most injurious form of "getting high" is the sniffing of gasoline fumes.

It is at play, though, that the romantic, carefree element of gamin life is truly on stage. The bounding energy of these boys moving through the street or plunging into a public fountain on a warm, sunny afternoon tugs

Left: A group of gamins has paused to build a fire on the sidewalk, tearing the layers of political posters off the adjacent wall. Such fires, which dot the city's streets, parks, alleys, and vacant lots each night, provide warmth and a temporary focal point. Below: Street children who are able to handle the transition to a more normal life may eventually find themselves at La Florida, *a residential program run by a Salesian priest. Children admitted to* La Florida *live in small self-governing groups within a dormitory complex.*



at the more preoccupied, restrained onlooker. The spontaneity and intensity of these activities reveal that these children have not lost the need or ability for play.

Movies are perhaps the all-time favorite source of entertainment for street children, providing a ready-made internal escape. In addition, the lines of waiting ticket buyers are a convenient source of income, and the theater itself offers refuge from the street. After the theater is cleared, its covered bay may serve as the night's shelter, the children spreading their cardboard bedding over the hard, cold tile. Another diversion is gambling, which takes the form of pitching small coins or pebbles. It is done with all seriousness: play is for keeps.

Hopping onto the bumpers of moving buses and trucks doubles as entertainment and transportation. This practice is hazardous, however, and all too often the weak or inexperienced fall off and are crushed by another vehicle. Such accidents go largely unnoticed and certainly unreported.

There are a number of government and private programs that attempt to address what each perceives to be the "gamin problem." Such formal programs are oriented toward either protection or rehabilitation, a philosophical dividing line that is immediately reflected in the services provided.

Consider a small program in Cali that is sponsored by the Red Cross and run by a Peace Corps volunteer. It provides an "ambulance service" in the form of a truck that goes out one night a week to visit areas where some of the children are known to sleep. The staff, equipped with a basic knowledge of first aid, treats many of the common cuts and bruises that, on the street, can so often lead to serious infection. A suspected serious medical problem can also be followed and the possibilities for treatment explored. Food and clothing are occasionally given out. This practice is reminiscent of the ambulance service the Salvation Army provided in Naples after World War II, where nightly distributions of food, clothing, and medical supplies were made from the back of a truck in an effort to reach street children and other urban poor.

Programs geared toward rehabilitation tend to view the child as deviant or delinquent and are generally restrictive and dictatorial in nature. The runaway rate from such settings is extremely high, fueling the myth that these children are uneducable delinquents, born of "bad seed" and beyond sustained help. For example, during the fall of 1979, Cali's largest government program received forty-five new boys in the same month that forty-six boys escaped. Some of the runaways have described it as an "oppressive prison," but its guards and chain-link fences are no match for the determination of children who at such an early age have already broken primary family bonds.

A different orientation has been adopted by an organization in Bogotá, which has a relatively new branch in Cali. This particular program works to preserve the child's sense of liberty and autonomy. The child decides whether to enter, and the door is al-

A cave on the outskirts of Bogotá is one of many places where gamins seek shelter. Some bed down in building entrances, near warm air vents, or in other favored locations. The gamins are just one segment of the urban poor, many of whom live in wretched conditions in crowded squatter settlements.



ways open in case he decides to leave. Interestingly, the most celebrated programs of the Children's Aid Society in turn-of-the-century New York, as well as Father Borelli's program for the street urchins of Naples, used exactly this approach.

For some street children, this program is a hospitality house, the source of regular meals, a clean change of clothes on occasion, and when sought out, a sympathetic ear. It can offer much more, however. After months of visiting, a child may ask to become an *internado*, one who lives in. Over time, he may formally complete the equivalent of a high school education and take up some career training. As they pursue anything from mechanics to music, the talent and intelligence of these children shine. A number are now students at the National University in Bogotá. Yet even this exemplary program is open only to those who are fully capable of the necessary transition. In essence, the program guarantees its own success. Children with severe emotional problems or neurological impairments are left by the wayside early on.

A few of the youngest children who have been placed in government programs may find themselves in a more traditional home through adoption, but this is quite uncommon. In contrast, betwen 1853 and 1890, some 90,000 vagrant children were sent west from New York City by the Children's Aid Society—sent for adoption to a place "where there is more to eat than there are mouths to feed and where a man's children are yet his wealth." A similar policy was followed by the Barnardo Homes of England, which sent thousands of urchins to families in Canada and Australia.

There are rare cases where, on their own initiative, individuals or families have taken in vagrant children and have carried them through the difficult transition from the streets. Others provide assistance through what the children call *contratas* ("contracts"). The *contrata* is an informal arrangement wherein an individual, a store, or a restaurant regularly provides a particular child with food, clothing, and the like, often at a fixed time of day. The child is seldom asked to reciprocate with direct service.

Twelve-year-old Hernán has two *contratas*, one for clothing and one for food. The first is with a woman whose car he guards when she stops at the post office. In addition to the better-than-average tip she gives him for his service, this woman regularly brings him some of her own boy's old clothing. She has contemplated taking him in, but her husband believes it would be difficult, both for Hernán and for them. "So I try to give him a little extra," she says. "It makes me feel good. But I still feel sad for him and for the others." Hernán's second *contrata*, shared by other boys, is with an open-air restaurant. In the late evening he comes to the back door to receive leftovers. The middle-aged proprietor tells me, "You know, I have admiration for the gamins—they are smart and tough, and they make it on their own. I'm like them a little, I've made this business on my own." Later, he qualifies his generosity by adding, "I do ask for something in return. I won't ever chase them away, but I prefer them not to beg in my restaurant. You understand—it bothers my customers, and it's bad for business. That's the way things are. Well, I do what I can."

The gamins deserve respect for their ability to survive, with so little help, against overwhelming odds. But their lives remain filled with pain and suffering. While the streets can fortify, they most often consume. The reality of the gamins' plight must not be romanticized or allowed to disappear into simplistic myths that prevent reflection, responsibility, and action. In particular, these children must not be viewed solely as deviant and in need of rehabilitation. To do so ignores their many strengths and, more important, ignores their most basic need, that of protection. □





THE LUXURY SEDAN THAT DID NOT HAVE TO BE RE-ENGINEERED TO FACE DIFFICULT TIMES.



Will the trials and tribulations of the automobile industry never end?

First came the Environmental Protection Agency and the need to re-engineer to meet the emission requirements.

Then came the gas crises and the need to re-engineer to meet the demands of the gas pump.

Then came last year's money crunch and the most serious challenge of all: the enlightened consumer.

And, with a certain predictability, the luxury sedan makers of the world reacted by bringing forth a slew of "revolutionary" new automobiles, each radically re-engineered to answer the perfectly reasonable question, "What is it that makes an expensive car worth the money?"

A question perhaps uniquely answered by the BMW 528i.

TECHNOLOGY DECADES AHEAD OF THE COMPETITION.

As some of the world's most exalted automobile manufacturers rush to update anachronistic technology—cutting cylinders, resorting to diesel fuel, tinkering with all manner of electronic gadgetry—one caveat should be observed: evolution, as any automotive expert will testify, is always far preferable to revolution. We are, after all, dealing with a machine made up of several thousand parts.

Which is perhaps the most convincing argument for owning the BMW 528i. A car developed and refined over two decades. An engineering concept so basically sound that an era of automotive restrictions has, if anything, proven it to be even more correct.

A SYNERGISTIC USE OF ELECTRONICS AND MECHANICS.

Car and Driver magazine has seen fit to predict, "In the not-too-distant future, most cars will be equipped with some form of electronic fuel injection simply because it is a more precise fuel-delivery system."

Far from just beginning to dabble in the sophisticated arena of electronics, BMW installed such a system in 1975.

With every engine revolution a computer receives and assesses signals from electronic sensors within the 6-cylinder engine itself. Then instantly determines the precise air/fuel mixture to be injected into the cylinder ports—optimizing emissions, fuel consumption and power development to a degree once considered merely within the realm of academic theory.*

So flawless is this marriage of electronics and mechanics that it has resulted in a virtual automotive paradox: an engine which not only performs with more fuel efficiency but with more power as well.

THE DRIVER COMPLETES THE MECHANICAL CIRCUIT.

The interior of the 528i, while classically restrained in style, denies its occupants nothing with regard to appointments or accessories.

But, perhaps because of our involvement with motor racing, we take a wholly different approach to the interior of an automobile.

An approach which includes the driver as a functioning part of the car.

A standard 5-speed transmission (automatic is available) affords the unaccountably unique opportunity to pick and choose one's own gears.

An advanced suspension system—independent on all four wheels—provides what one automotive journalist hailed as "a confidence-inspiring stability." Giving the driver an uncanny feel for the road.

EXTRAORDINARY ENGINEERING IS AN EXTRAORDINARY INVESTMENT.

BMW has always contended that only one thing makes an expensive car worth the money: Extraordinary engineering.

The BMW 528i has itself turned that contention into fact.

For, according to the Oct. 1980 NADA Used-Car Guide, over the past 5 years, the 5 Series has retained an astonishing 77.9% of its original price.

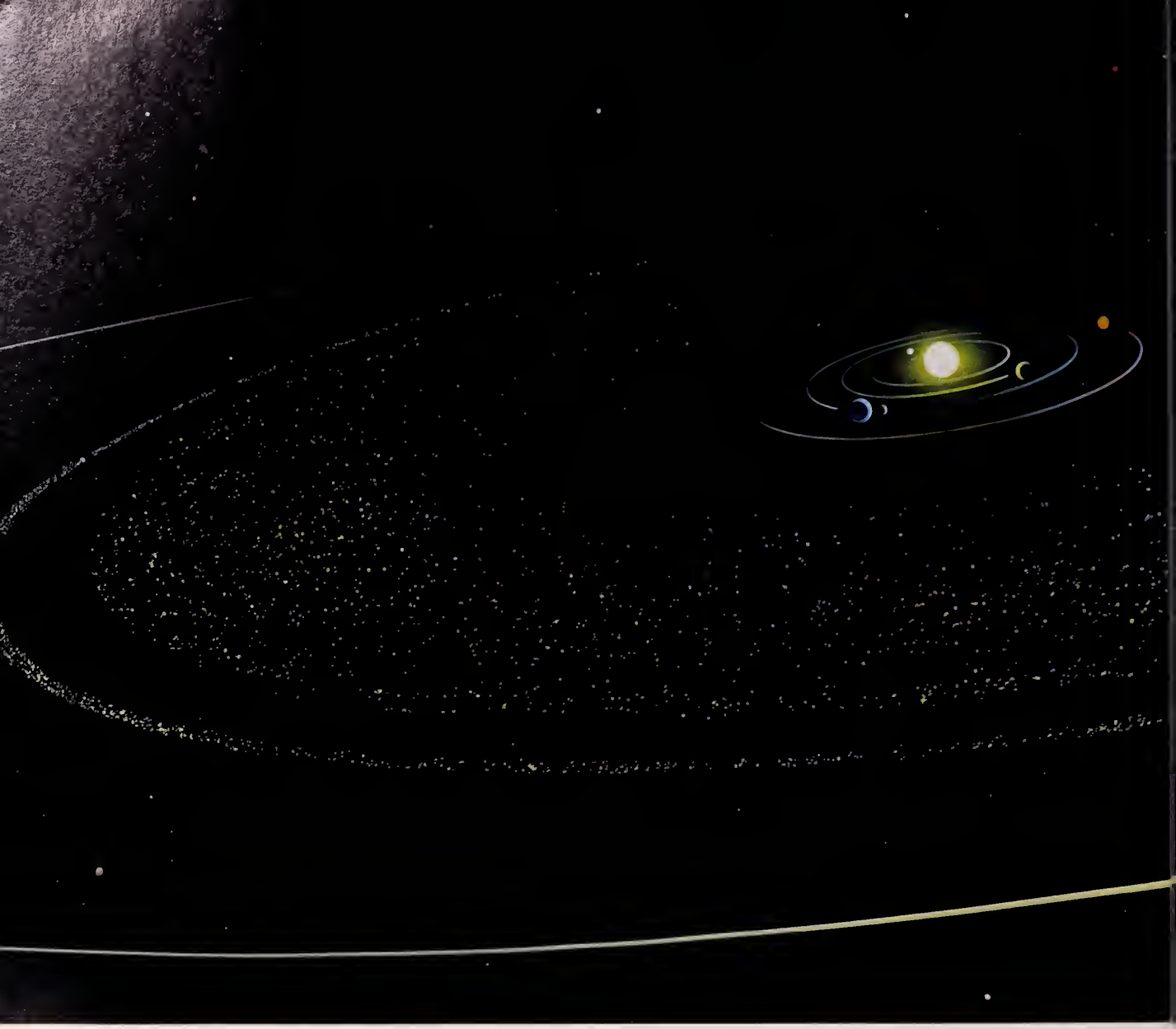
A figure which neither the Mercedes 280E, nor the Jaguar XJ6, nor Cadillac can approach.

If you find the notion of owning a BMW intriguing, phone your nearest BMW dealer and arrange a thorough test drive.

THE ULTIMATE DRIVING MACHINE.

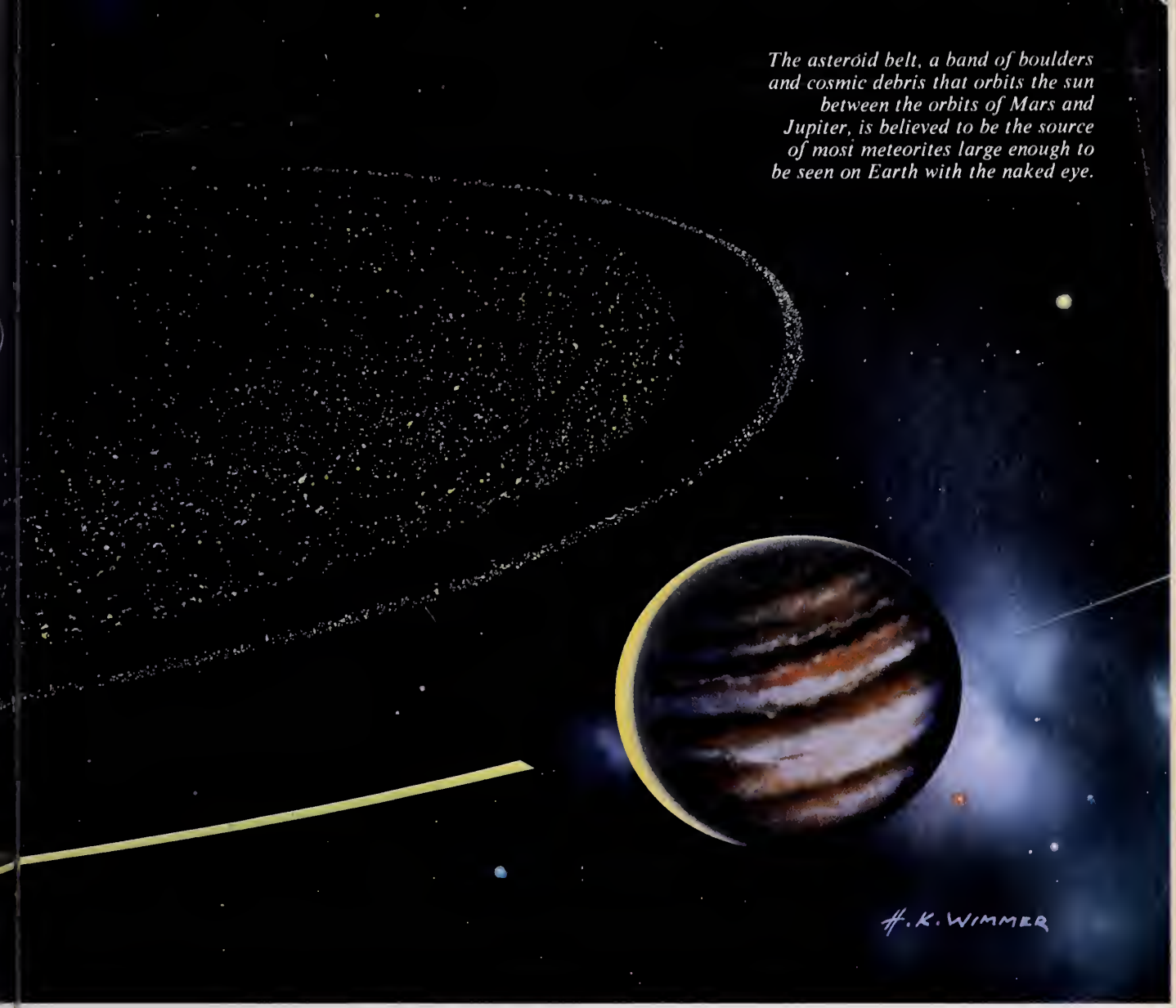
BMW MOTOR GERMANY

*For example, the BMW 528i (with 5-speed standard transmission) delivers 18 EPA estimated mpg, 30 estimated highway mileage and, based on these figures, an estimated cruising range of 396 mi and a highway range of 492 mi. (Naturally, our fuel efficiency figures are for comparison purposes only. Your actual mpg and range may vary depending on speed, weather and trip length. Your actual highway mileage and highway range will most likely be lower.) © 1981 BMW of North America, Inc. The BMW trademark and logo are registered trademarks of Bayerische Motoren Werke A.G.



From Eternity to Here

A *Natural History* Special Supplement on Meteorites



The asteroid belt, a band of boulders and cosmic debris that orbits the sun between the orbits of Mars and Jupiter, is believed to be the source of most meteorites large enough to be seen on Earth with the naked eye.

Meteorites are pieces of rock that rain from the heavens. It may be difficult to believe that rocks can fall from the sky—especially when looking at such large objects as the Ahnighito, the 34-ton hunk of Cape York meteorite that is the centerpiece of the new Arthur Ross Hall of Meteorites at the American Museum of Natural History. Nevertheless, rocks do drop out of the sky. More than 3,000 of them have been collected and placed in museums and university laboratories around the world, where they can be gazed at, studied, and analyzed.

For museum visitors, meteorites may be the oldest objects yet seen close up. For scientists, meteorites serve as messengers from the outer realms of space, bearing information about the early solar system.

Many meteorites are now believed to come from the asteroid belt, a band of debris and rocks that orbits the sun about 200 to 300 million miles out, between the orbits of Mars and Jupiter. It is the shape of the meteorites' orbits that suggests that these objects come from the asteroid belt. This view is supported by the fact that the asteroid belt marks the outer limit of the terrestrial, or rocky, planets: Mercury, Venus, Earth and its moon, and Mars. Beyond the asteroid belt, the only rocky bodies known are the small satellites, or moons, of the gigantic gas planets such as Jupiter and Saturn. It is important to note, however, that not all meteorites come from asteroids. There are also tiny meteorites, about the size of dust particles, that are believed to come from comets.

Whatever their origin, meteorites have been classified according to their most obvious physical characteristics into three main types: stony meteorites, composed predominantly of silicate minerals; iron meteorites, made up, as their name suggests, almost entirely of metallic iron; and stony-irons, which are half stony and half metallic. Within these main types there are many subdivisions and differences.

Type of Meteorite	Approximate Percentage of Known Meteorites
Stony — chondrite — ordinary chondrite	72%
Stony — chondrite — carbonaceous chondrite	13%
Stony — achondrite	8%
Iron	6%
Stony-iron	1%

A polished ultrathin section of an ordinary chondrite shows one of the small, rounded masses known as chondrules that are typically embedded in this type of meteorite. Ordinary chondrites are the most numerous of all known meteorites. This one fell in India in 1976.

R. Beauchamp; Batelle Pacific Northwest Laboratories

The stony meteorites, in particular, are subdivided into two major groups, chondrites and achondrites. These designations come from the small, round objects called chondrules that were discovered when meteorites were first studied under a microscope in 1869. Chondrules are tiny blobs of mineral material—glass and crystals—about one millimeter in diameter. The chondrites contain chondrules; the achondrites do not.

Although both the chondrites and the achondrites are stony meteorites, they are very different in appearance. No terrestrial rocks contain chondrules, and therefore no earth rocks look like the chondrites. The achondrites, on the other hand, often look like those formations of igneous earth rocks in which small angular fragments are piled together in a chaotic heap whose gaps are filled with still smaller fragments. This kind of rock formation is called a breccia, and breccias similar to those of achondrites were brought back from the moon by the Apollo and Luna missions. Studies of the lunar specimens have shown that a single breccia can include fragments of many different types of rock instead of only one. Similarly, a variety of extraterrestrial rock types will often be found in a single brecciated achondrite, so that the meteorite is a particularly rich source of information. The chondrites are the most abundant of the known meteorites, making up about 85 percent of the identified finds. Achondrites constitute about 8 percent of the total.

The chondrites are themselves further divided into ordinary chondrites and carbonaceous chondrites. Both kinds are made of primordial and undifferentiated (that is, unseparated) material but there are important differences between them. Carbonaceous chondrites are the most primitive of all the meteorites, containing complex organic molecules that may, under appropriate environmental conditions, be the precursors of life. They also contain water bound structurally to their minerals. In addition, carbonaceous chondrites have inclusions that were created at high temperatures: these are the very earliest minerals, produced when the solar nebula, a hot cloud of gas, began to collapse and condense to form the chondritic materials from which all the planets and the sun evolved. Ordinary chondrites are also primitive, being about 4.5 billion years old, but unlike the carbonaceous chondrites, they contain neither organic components nor water. They are presumed to record later chapters than the carbonaceous chondrites in the evolution of the solar system.

Iron meteorites are very different from stone ones. There are no rocks on the surface of the earth that look like them. The only place on the planet where anything similar might be found would be 5,000 kilometers beneath our feet in the earth's semimolten core. Because metal is less brittle than rock, iron meteorites are less likely than stony ones to break up as they travel through the atmosphere, so that very large pieces can sometimes be found. The iron Ahnighito, for example, is the largest piece of a meteorite on display in any museum in the world. It is not, however, the largest meteorite that has ever been found. An iron meteorite called Hoba, which may weigh more than 60 tons, lies where it fell in Namibia (formerly South-West Africa); it is too big to be easily moved. More than 500, or about 6 percent, of all known meteorites are irons. The stony-irons are a smaller group than either the stones or the irons. Only about sixty-five to seventy of the known meteorites are in this group, and like the irons, the stony-irons do not resemble any rocks of any type found on the earth.

The studies that are currently being conducted on meteorites are largely devoted to determining their composition, their age, and the processes by which their components have been differentiated. Composition and processes of differentiation are determined by means of chemical analyses. Age is determined by measuring the abundance in a meteorite of certain radioactive isotopes that have known rates of decay and can serve as clocks.

The articles that follow in this Special Supplement of *Natural History* describe the improved understanding of the nature of meteorites that has resulted from these ongoing studies and the role that meteorites have come to play in informing scientists about the development of the planetary system. The oldest meteorites yet dated are about 4.6 billion years old, some 100 million years older than the earth or the moon. Since they predate anything found on the planet, they can help fill in the earliest chapters of our own history that have been obliterated on the earth. □



Long-playing Records

Invaluable clues to the history of the earth and the moon come from the study of meteorites

by John A. Wood

Meteorites are not merely curiosities that fill our museums. They are crumbs and scraps left over from the formation of the solar system, and they retain a record of the things that happened at that time.

Our sun was formed by the drawing together of wisps of gas and specks of dust from the space between the stars. As a byproduct of this process, vast numbers of lumps of earthy grains and icy material were left spinning in orbits around the infant sun. The orbits were more or less round and concentric, lay in nearly the same plane, and all the lumps revolved in the same direction, so there was an organized motion of the ensemble like that of a thin, dark disk turning slowly about the sun. The icy lumps were probably present only in the outer

Before the earth's crust solidified, meteorites bombarding the planet may have sent up fountains of lava. In Chesley Bonestell's painting, "Formation of the Earth's Crust," a swollen moon looms on the horizon.

Future Life Magazine; Chesley Bonestell



reaches of the disk, far from the sun's heat.

At this point of development the earthy lumps were still random mixtures of those chemical elements that had been present in the interstellar dust grains that were drawn into the solar system. Actually, various complicated and interesting things had happened to the interstellar dust grains by now, but there had been no major sorting-out, or fractionation, of the chemical elements.

As their orbits carried these lumps of primordial material slowly past one another, they tended to clump together and gradually build up into larger masses. The biggest of these aggregations, or planetesimals, attained diameters of several hundred kilometers. Planetesimals represent a stage halfway between lumps and planets.

Some of the planetesimals, probably the largest ones, grew very hot inside. The source of the heat is poorly understood, but there is no doubt the heating occurred since we can still see the effects it had by examining meteorites. The planetesimals in question melted inside, lava erupted on their surfaces, and the nickel-iron metal they contained melted and sank to their centers, collecting into dense cores.

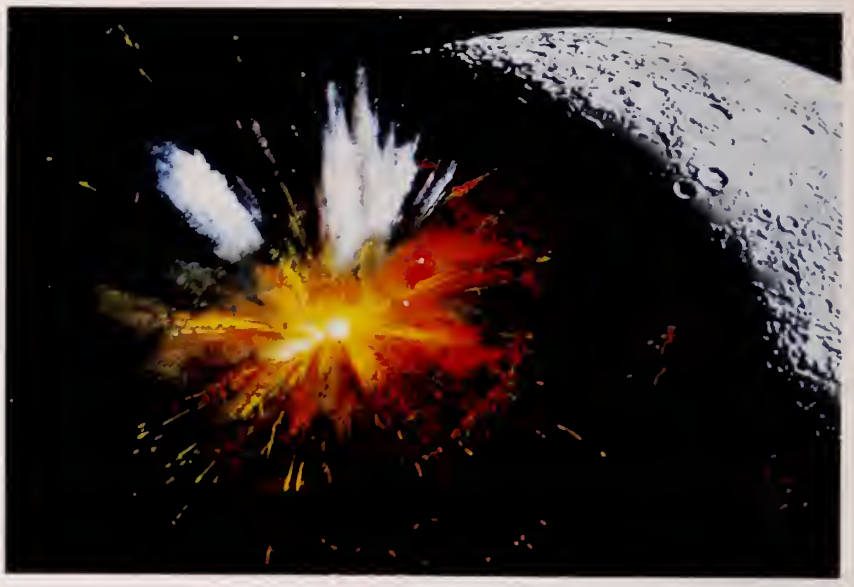
The aggregation of lumps and the growth of planetesimals continued, but the orbital motions of these objects became more disorderly. Instead of merging into a single, larger body when they chanced to meet, the planetesimals sometimes struck one another at such high speeds that they were smashed and the fragments were dispersed. The planetary disk orbiting the sun now contained a wide diversity of bodies: some were still growing, others were fragments of once larger bodies; some still had their primordial, unfractionated composition, others were fragments of the lava layers and metal cores from planetesimals that had melted and fractionated.

Eventually, all the lumps and fragments and planetesimals in the innermost solar system were swept up into five large bodies: Mercury, Venus, Earth, Earth's moon, and Mars. Over the ages, these objects, acting like giant vacuum cleaners, have totally cleansed their zone of the solar system of primordial crumbs. The materials that were swept up into the planets have been assimilated and repeatedly fractionated by geologic processes—



Another Bonestell painting was inspired by the hypothesis that the huge lunar Mare Imbrium resulted from the collision of a large meteorite with the moon.

Frederick I. Ordway and the Alabama Space and Rocket Center Bonestell Collection



for example, melting and erosion—to such an extent that their original identities are almost totally lost.

Between the orbits of Mars and Jupiter, however, there is a vast expanse of solar system space that does not contain a major planet to act as a vacuum cleaner. In this zone untold numbers of lumps, boulders, fragments, and planetesimals—the asteroids—are still in orbit. This zone appears to be a place where the forces that conspired to draw lumps and planetesimals together into planets failed; the accretion process here never got beyond the planetesimal stage. And since the small bodies of the asteroid belt were never exposed to the vigorous geologic activity of a full-grown planet, many of their earliest properties remain imprinted in them. Thus the material properties as well as the accretional state of the asteroids are records of a time long past, preserved in "deep freeze" like the carcass of a Siberian mammoth.

Orbits are not immutable. Every asteroid is tugged at by the gravity of every planet, as well as that of the sun. Most of the planets are so far from the asteroids that the tugging is insignificant. Sometimes, however, an asteroid passes close enough to Mars or Jupiter (which are closest to the asteroid belt) to be subjected to a substantial tug that somewhat reshapes its orbit. Over a period of hundreds of millions of years, the cumulative effect of a huge number of close passages and gravitational tugs can change an asteroid's orbit so much that the asteroid dives deep into the solar system, crossing the orbits of Mars and the earth in each revolution before it swings around the sun and loops back out to the asteroid belt.

In such an orbit, the asteroid stands a certain chance of colliding with the earth each time it comes around the planet (see "A Near Miss," *Natural History*, March 1981). Actually, it is far more likely to be a small fragment of an asteroid that collides with the earth than one of the kilometers-large objects that astronomers see in the asteroid belt, because small fragments (created by collisions between asteroids) are vastly more numerous than large asteroids. In fact, pieces of asteroids actually do encounter the earth hundreds of times each year. They are slowed down as they penetrate the atmosphere and drop to the ground. Those we find are called meteorites, a term applied to all rocks that fall to the earth from space, whether they should happen to come from the asteroid belt or anywhere else.

All the types of planetesimal material mentioned earlier can be seen in the meteorite exhibit of a natural history museum. The primordial, unfractionated material alluded to is represented by chondritic meteorites, a broad class of meteorites that falls most frequently to Earth and includes the so-called ordinary chondrites. The lava that erupted to the surfaces of melted planetesimals long ago is present in the form of certain meteorites known as achondrites. And iron meteorites are fragments of the cores of similar melted bodies. Is this information a vindication of the theory of planet growth sketched at the beginning of this article? On the contrary; it was principally the study of meteorites that led to the theory.

Do all meteorites come from the asteroid belt? Many meteoriticists are convinced that they do. Nevertheless, there are nagging doubts about the source of the ordinary chondrites, stony objects that are the most abundant group of meteorites. The trouble is that objects in Earth-crossing orbit do not survive for very long. We have two ways of knowing this. First, by measuring the amounts of new isotopes that have been created in a meteorite by cosmic rays in space, we can learn how much time has elapsed since the meteorite was knocked out of its parent asteroid. (Cosmic rays striking the atoms of a meteoroid alter their makeup, creating new isotopes in the process.) Meteorites are shielded from these cosmic rays as long as they remain buried in the parent body. "Cosmic ray exposure ages" of about ten million years are typically found for ordinary chondrites. This is a very short time compared with the total age of the solar system—four and a half billion years.

Second, we can calculate the odds that an object in Earth-crossing orbit will collide with any planet during each circuit of its orbit, and how long the object will last, on the average, before this happens. The answer to how long is, again, about ten million years.

If ordinary chondrites last such a "short" time in Earth-crossing orbits, there must be some abundant source of supply that keeps feeding new fragments into Earth-crossing orbits to replace the losses, otherwise no ordinary



A real lunar crater called Eratosthenes was created by the impact of a meteorite. This photograph was taken during the Apollo 17 mission, the last of the manned lunar flights, launched in December 1972.
NASA

chondrites would be left in these orbits to fall to the earth today. The process sketched earlier, wherein the gravitational tugging of Mars or Jupiter gradually warps the orbits of asteroidal fragments until they cross the earth's orbit, is much too slow, taking many millions of years.

One proposal concerning the source of ordinary chondrites is that they are not derived from the asteroid belt at all, but from comets. Comets are small masses of ice and grains of interstellar dust, in which the "ice" is not only the water ice we are familiar with but also frozen compounds of ammonia and other volatile substances. When comets approach the sun, their ices begin to vaporize and stream out, giving rise to the tails and fuzzy cloudlike masses, or comas, we associate with these objects. Dust particles can be seen streaming away from comet nuclei, as the ices that enclosed them waste away.

Comets are thought to be icy planetesimals that accumulate in the cold outer reaches of the solar system, analogues of the rocky planetesimals that are preserved in the asteroid belt. They were not stored in the early solar system, however, but thrown out of it by the mighty gravitational forces of the outer planets—Jupiter, Saturn, Uranus, and Neptune—when they strayed too close to one of them. Most ejected planetesimals were lost forever to interstellar space, but some remained in slow, coasting orbits around the sun, far outside the orbit of Pluto. These orbits, too, change because of the gravitational tugging on them of stars in the galaxy other than our sun, and every year several icy planetesimals are sent plunging back into the solar system. There, additional gravitational interactions with the planets can place a steady and fairly copious flow of them in Earth-crossing orbits similar to those of the ordinary chondrites. If the nuclei of comets contain large rocks and boulders as well as dust, they would be a possible source of chondritic meteorites.

A serious difficulty with this hypothesis is that the character of the rock in ordinary chondrites shows it has been metamorphosed, or transformed, by high temperatures (roughly 1,000°C) over periods of millions of years. This is hard to reconcile with a former existence in a mass of ice. I have suggested a variation on this theme, namely, that rocky planetesimals from the inner solar system were gravitationally ejected just as icy planetesimals were from the outer solar system. Some of these earthy objects ended up in the same slow orbits as the icy planetesimals, and their orbits subsequently were changed by the same gravitational interactions that govern the comets. Since these objects would move very fast when they enter the inner solar system and do not conspicuously stream gas, they would escape the notice of astronomers. Such objects could be fed into Earth-crossing orbits at a rate rapid enough to replace losses, and unlike the icy planetesimals, it is easy to picture them having high-temperature histories.

Whatever their origin, the extraterrestrial objects that collide with the

earth do so at very great speeds, between ten and thirty kilometers per second. (For comparison, a .30 caliber rifle bullet moves at about 0.7 kilometer, or less than half a mile, per second.) They would wreak great havoc if it were not for the shielding effect of the atmosphere we live in.

A meteorite has to punch its way through a column of air having the same cross-sectional area as the meteorite itself, and which is as long as the meteorite's path through the atmosphere. If the meteorite is small, the mass of air in this column will be greater than the mass of the meteorite. In colliding with such an amount of air, the meteorite is gradually slowed until it falls to the earth at a velocity no greater than if it had been dropped out of an airplane, less than fifteen meters per second.

If, on the other hand, the meteorite is large, the results are different. The mass of the meteorite increases as the cube of its diameter, while its cross-sectional area—and therefore the mass of air it must shove aside—increases only as the square of its diameter. Meteorites larger than a few meters in diameter are heavier than the air they must displace, so they are not much slowed by it. Very large meteorites strike the ground at velocities greater than ten kilometers per second and explode with greater energy than a comparable weight of TNT.

Fortunately for us, large meteorites are very rare. The objects that come to the earth from space are fragments from collisions between asteroids (and perhaps comets), and collisions tend to create more small pieces of debris than large ones. Thus, for every thousand-kilogram fragment, a collision would result in about ten hundred-kilogram pieces, roughly a thousand ten-kilogram chunks, and so forth. The vast majority of extraterrestrial fragments that collide with the earth are in the small-size, slowable range. But not all the incoming fragments are in this range. Occasionally the earth is struck by meteorites large enough and fast enough to blast huge craters in it. The best example of such a structure is the Arizona Meteor Crater, a pit more than a kilometer wide and a hundred meters deep. The desert around the crater is strewn with iron meteorite fragments. Cosmic rays had generated radioactive isotopes in these meteorites while they were in space; the amounts of these isotopes found to be still present indicate that the meteorite struck the earth at least 2,700 years ago.

Even larger craters can be found elsewhere. They are older and less well preserved than the Arizona crater, having been worn down by geologic erosion. Many are still preserved in the terrain of the Canadian Shield, an expanse of ancient granitic rock extending from the province of Quebec to the Northwest Territories. Craters are abundant in this region. The Shield is geologically stable, erosion is slower there than elsewhere, so craters are preserved longer and tend to accumulate. Luckily no meteorites large enough to form explosion craters have fallen in historical times. (A titanic explosion that occurred in an unpopulated area of Siberia in 1908 left no crater or meteorite fragments and is thought to have resulted from the impact of an icy comet nucleus.)

Nevertheless, the law of averages dictates that extremely large objects must strike the earth at infrequent intervals. These impacts could affect the earth profoundly and on a global scale. Recently it has been proposed that an object roughly ten kilometers in diameter struck the earth 65 million years ago (see "The Belt of an Asteroid," *Natural History*, June 1980). This is not unreasonable, given the present rate of fall of small meteorites and the relative abundances of small and large meteorites. The huge impact postulated is believed to have thrown such a colossal mass of pulverized rock into the air that the atmosphere of the whole earth was clogged with a pall of dust for several years. The dust cut off sunlight from the earth's surface to such an extent that plant life was decimated and as a consequence many forms of animal life became extinct, including the dinosaurs. (The depletion of plant life starved the herbivores, and their extinction, in turn, starved the carnivores.) As evidence of this event, a thin layer of clay—presumably dust deposited from the atmospheric pall—is found worldwide in sedimentary rock strata at the level corresponding to the boundary between the Cretaceous and Tertiary periods, the time when the dinosaurs vanished. The clay everywhere contains trace elements in proportions characteristic of meteorites.

Of course, meteorites also bombard the moon. Since there is no atmosphere there to slow them down, small meteorites as well as large ones blast and crater the lunar surface. Because geologic erosion does not operate on the moon as it does on the earth, lunar craters have persisted and accumulated through the ages, resulting in the pockmarked landscape visible today. The pulverizing effect of meteorite impacts, large and small, created the deep layer of lunar dust that we saw the astronauts walking in during the Apollo missions to the moon. Bits of meteorites can be found in the lunar soil samples they brought back.

There is a possibility that a major meteorite impact on the moon has been witnessed from the earth. In the chronicles of Gervase of Canterbury, A.D. 1178 (translated from the Latin by R.Y. Hathorn), an account is given by five men who had sat outdoors on a July night:

> Now there was a bright new moon, and as usual in that phase its horns were tilted toward the east; and suddenly the upper horn split in two. From the midpoint of this division a flaming torch sprang up, spewing out, over a considerable distance, fire, hot coals, and sparks.

The place on the lunar surface where this would have occurred can be pinpointed, and when photographs of this area taken from the Apollo spacecraft are examined, a fresh, twenty-kilometer-wide crater is found. The formation of this crater (named Giordano Bruno for the sixteenth-century Italian astronomer) may have caused the dramatic spectacle described above, although the calculated probability of such a large impact occurring on the moon during the entire period of recorded history is only about one chance in a thousand.

There is no question, however, that asteroids are out there, though, and must occasionally collide with the earth. Impacts as large as the ones that may have destroyed the dinosaurs and created the lunar crater Giordano Bruno are estimated to occur every thirty million years or less. When will the next one fall? □

Comets are believed to be the main source of the dust particles that produce meteor showers and so-called shooting stars in the night sky. Shown here is Comet Kohoutek, which got brilliant advance notices but did not live up to expectations in 1974.

NASA





A Lode of Meteorites

Antarctica has been found to be an exceptional storehouse of these extraterrestrial objects

by Brian Mason

Conventional wisdom would predict that meteorites falling in Antarctica would soon be buried in the ice that covers almost the entire continent and never reappear, except perhaps in the moraines exposed in a few coastal areas. And the chance of recognizing the odd meteorite in the mass of rock debris in a moraine is small indeed.

Prior to 1969, only four meteorites had in fact been found on the whole continent of Antarctica. But in 1969 a Japanese expedition picked up nine meteorites in a small area on the ice-cap near the Yamato Mountains, in the African sector of Antarctica. When that news was first reported, scientists thought that the find might represent a single meteorite that had broken into several pieces during or after its fall. However, mineralogical



Ursula B. Marvin; Smithsonian Astrophysical Observatory

The midnight sun illuminates the region south of Allan Hills, Antarctica, where many meteorite specimens have been found.

examination showed that several different meteorite types were present, representing several distinct falls. The results of that examination have been amply confirmed by additional searches in the same region, in 1973, 1974, 1975–76, and 1979–80, that have yielded more than 3,000 specimens in all.

The early work on the Yamato meteorites was reported at a meeting of the Meteoritical Society in Davos, Switzerland, in August 1973. William A. Cassidy of the University of Pittsburgh, a scientist with long experience in the search for meteorites, who attended that meeting, was immediately struck by the evidence for some concentrating mechanism—a process that would explain the occurrence of several different meteorite types in a small area—and deduced that special conditions unique to the Antarctic ice-cap must be responsible. He concluded that similar conditions should exist elsewhere in Antarctica. The success of subsequent expeditions led by Cassidy to areas other than the Yamato Mountains has clearly demonstrated the validity of his thesis.

Statistics on meteorite falls are imperfect, since falls are unpredictable and many go unobserved. However, extrapolation from observations in densely populated regions indicate an average meteorite infall of one per million square kilometers per year, or about 500 a year for the entire planet. Since the oceans cover about 70 percent of the earth's surface, only about 150 meteorites a year fall on land and can be recovered. Because much

of the earth is sparsely populated and recovery is difficult in forested or rocky terrain, the recovery rate is only about ten per year. Statistically, over a period of a million years, there should be one meteorite in each square kilometer. But in the Antarctic, areas of concentration, containing many more meteorites than statistically predicted, are found. The Antarctic icecap evidently functions as a collecting and concentrating medium.

What peculiar features of the Antarctic continent produce these unique concentrations of meteorites? The icecap has existed for millions of years —possibly since the Miocene, some twenty million years ago. Meteorites have fallen on the icecap throughout this period and have been buried in the ice, which moves slowly toward the coast. Much of the ice eventually reaches the coast and either melts or drifts away in the form of icebergs. In some places, however, the ice flow is blocked by mountain ranges. The ice stagnates and is slowly removed by ablation, that is, by evaporation and wind erosion, but is constantly replaced by newer ice from the interior. Solid objects within the ice, the meteorites for example, will remain on the surface and accumulate as a unique form of "lag gravel." It should be realized that much of Antarctica is essentially a dry desert, in which ablation greatly exceeds the accumulation of new snow.

This scenario accounts for the areas of meteorite concentration in association with mountain ranges that block the flow of the inland ice. If the Antarctic icecap has existed for twenty

Sites of Antarctic Meteorite Finds



Expedition	Date	Area Investigated	Meteorites Found
Mawson (Australian)	1912	Adélie Land	1
Lazarev (Russian)	1961	Lazarev Base	1
U.S. Geological Survey	1962	Thiel Mountains	1
	1964	Neptune Mountains	1
Japanese	1969	Yamato Mountains	9
	1973		12
	1974		663
	1975-76		307
	1979-80		Approx. 3000
Joint United States-Japanese	1976	Mount Baldr	2
	1977	Allan Hills	9
	1977-78		307
	1978-79	Darwin Glacier	47
		Allan Hills	267
New Zealand	1978-79	Reckling Peak	5
		Darwin Glacier	6
United States	1978	Purgatory Peak	1
	1979-80	Allan Hills	54
		Reckling Peak	15
		Elephant Moraine	11

This fragment of a stony meteorite was photographed on the ice near Mount Baldr where it was found in 1976 by a joint Japanese-U.S. expedition.

William A Cassidy



million years, there is the possibility of recovering meteorites that have fallen over a very long period of time. (Meteorites falling in temperate and tropical areas are likely to disappear within a few thousand years because of weathering, erosion, or burial.) The Antarctic meteorites fell into the equivalent of a "deep freeze" and have thus been preserved with a minimum of terrestrial alteration and contamination. Given this unique concentration of meteorites, there is a good chance of finding rare or previously undescribed meteorite types.

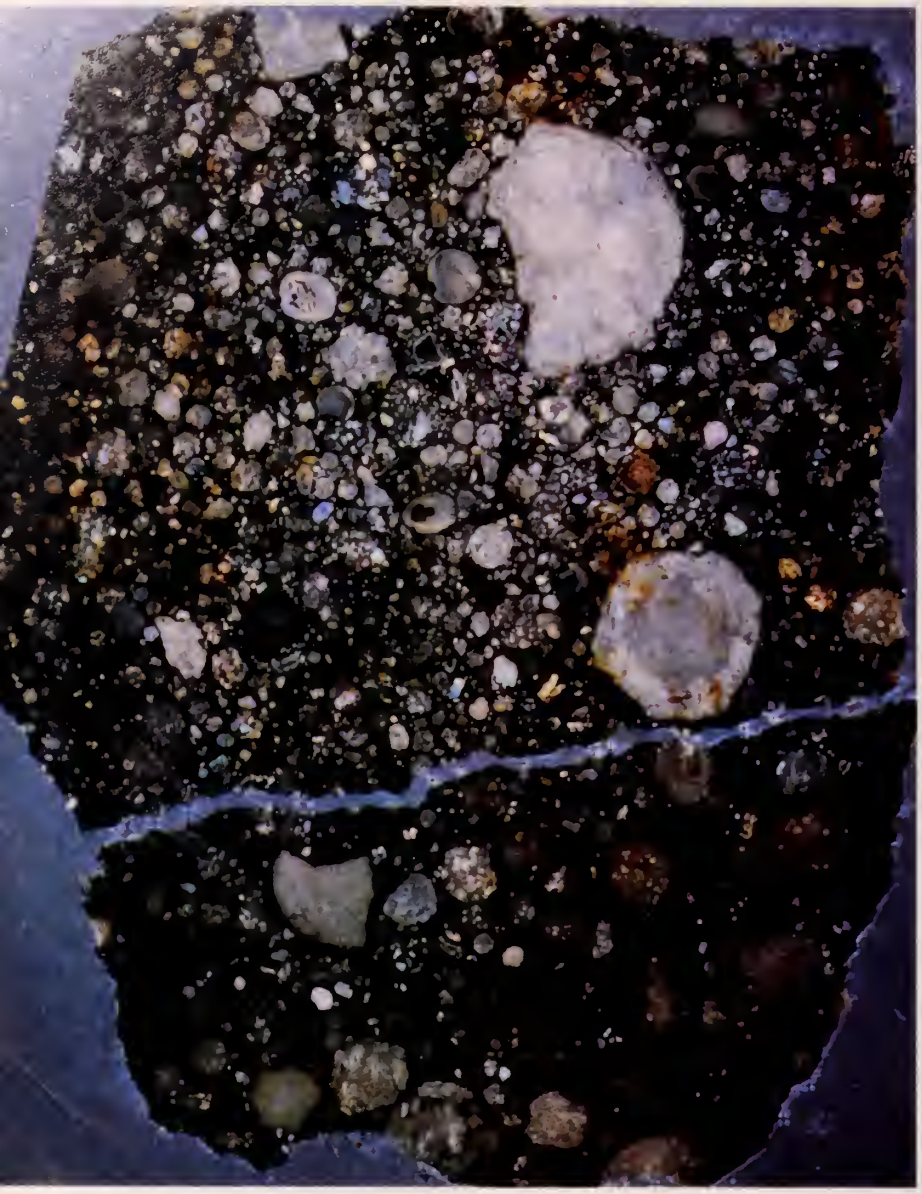
How long have the Antarctic meteorites been on the earth? What are their terrestrial ages? Conceivably we may expect any age from the present back to the time of inception of the icecap, perhaps twenty million years ago. Meteorites carry within them a time clock in the form of radioactive isotopes produced by cosmic-ray bombardment in outer space. When meteorites land on the earth, this cosmic-ray bombardment is effectively terminated, and the induced radioactivity decays as a function of time. Approximate terrestrial ages have been measured for twenty-seven Antarctic meteorites, and the calculations range up to 700,000 years. This range includes the oldest terrestrial ages ever measured on stony meteorites.

The old terrestrial ages of the Antarctic meteorites have introduced a new and exciting possibility, that of using meteorites as time probes. Measurement of radioactivity induced by cosmic rays should make it possible to span a range of terrestrial ages extending back twenty million years to the time of the inception of the Antarctic icecap. The concentrations of meteorites now being found near the margins of the icecap may well yield specimens old enough to provide critical information on the formation, expansion, and flow directions of the great mass of ice blanketing the Antarctic continent.

One of the unanswered questions that has troubled meteoriticists is whether the meteorites collected and described over the past two centuries are representative of the total influx of meteorites. Are there meteorite types that have escaped recognition and collection? Has the range of meteorite types changed during geologic time? The Antarctic meteorites provide some clues to answering these questions.

The specimens so far classified from the Antarctic collections are: 87 percent chondrites; 5 percent achondrites; 7 percent irons; and 1 percent stony irons. These percentages agree remarkably well with those for all recorded meteorite falls. For the 809 confirmed falls recorded worldwide up to 1977 these percentages pertain: 85 percent chondrites; 8 percent achondrites; 6 percent irons; and 1 percent stony irons. Thus the Antarctic collections appear to be a representative sampling of the terrestrial meteorite influx. A point of interest is that iron meteorites are present in their statistical proportion. It might be expected that because of the great difference in density between nickel-iron and ice, irons would sink to the bottom of the icecap, never to resurface.

Martin Prinz, AMNH



Left: Many chondrules can be seen in this section of an ordinary chondrite from Allan Hills. This meteorite resembles ordinary chondrites found in other parts of the world. Right: A thin section through an achondrite shows no chondrules. This meteorite looks like certain kinds of terrestrial igneous rocks.

Institute of Meteoritics, University of New Mexico

Because of their pristine condition and scientific value, Antarctic meteorites are handled with the same care that is given to lunar rocks. Beginning with the 1977–78 field season, the following procedures have been followed. After being photographed in place, the meteorites are wrapped in Teflon bags, sealed with tape, and packed in sterile, padded metal boxes provided by the Johnson Space Center in Houston. The boxes are flown to McMurdo Station and then shipped refrigerated to the Space Center, where they are unpacked and the meteorites are placed in a cold storage room at −40°C. Each bag, containing one or more meteorites, is transferred from the storage room to the processing laboratory, where every meteorite is compared to its field photograph to confirm its identity. Each meteorite is then rephotographed (usually from several angles) and weighed; its external features are described; a chip is taken for thin sectioning and petrographic description; and a permanent number is assigned. Once they have been documented, the meteorites are sent to researchers according to the procedures previously established for lunar rocks. As soon as possible after receipt at the Space Center, a piece of each meteorite is sent to the Smithsonian Institution in Washington, where I am responsible for the initial description, classification, and publication of the descriptions.

Meteorites are normally named for the geographical feature (town, river, mountain, and so forth) nearest to their place of discovery. This procedure, however, is clearly impractical for large concentrations of meteorites found in small areas, and a name-and-number combination has been adopted. This combination is a three-letter abbreviation for the locality (for example, ALH for Allan Hills); a letter for the field party (A for the first party, B for the second, and so on); two digits for the year of the field season (77 for the 1977–78 season); and a three-digit number that identifies the individual specimen. Thus specimens collected by the first field party at Allan Hills during the 1977–78 season are numbered from ALHA77001 through ALHA77307.

Meteorites have been aptly described as the poor man's space probes —extraterrestrial materials arriving cost-free from outer space and carrying within them a history, albeit imperfectly preserved and difficult to decipher, of events in the universe over the past five billion years. The discovery of the Antarctic meteorites provided a large supply of unique research materials at a propitious time —when a large number of laboratories and scientists experienced in the investigation of lunar rocks were ready and anxious to extend their research to other extraterrestrial material. A fruitful cooperation among specialists in Antarctic meteorites, specialists in lunar rocks, and those studying other planetary bodies has been established, and concurrent investigations of these materials are providing comparative studies of wide-ranging importance for our comprehension of the origin and evolution of the solar system. □



Telltale Inclusions

Mineral grains in the Allende meteorite are studied in order to understand the transition from a cosmic gas cloud to the early solar system

by Lawrence Grossman

Scientists have long recognized that a record of events that occurred at the very beginning of the solar system is preserved in the carbonaceous chondrite meteorites because these objects miraculously escaped later processes, such as vulcanism, that would have erased this information. During the 1960s, the supposition was that these extraterrestrial samples were composed of the very mineral grains that condensed from the solar nebula, the hot gas cloud postulated to have given birth to the sun and the planets. Direct evidence was difficult to obtain, however, as existing specimens of these precious meteorites were considered too small for the extensive studies necessary to test the hypothesis. This barrier was broken suddenly on February 8, 1969, when thousands of pieces of a meteorite fell over a large rural area in the valley of el Rio del Valle de Allende in northern Mexico, providing scientists with four tons of material from a single carbonaceous chondrite. So much material became available that chunks weighing several kilograms were sliced up like loaves of bread. The slicing revealed for the first time that some types of carbonaceous chondrites are heterogeneous mixtures of different types of inclusions, many of which are large enough to be individually sampled and analyzed by several different techniques. I will concentrate here on the wealth of information that was obtained by using these techniques on the coarse-grained, calcium-rich inclusions that constitute about 5 percent of the Allende meteorite.

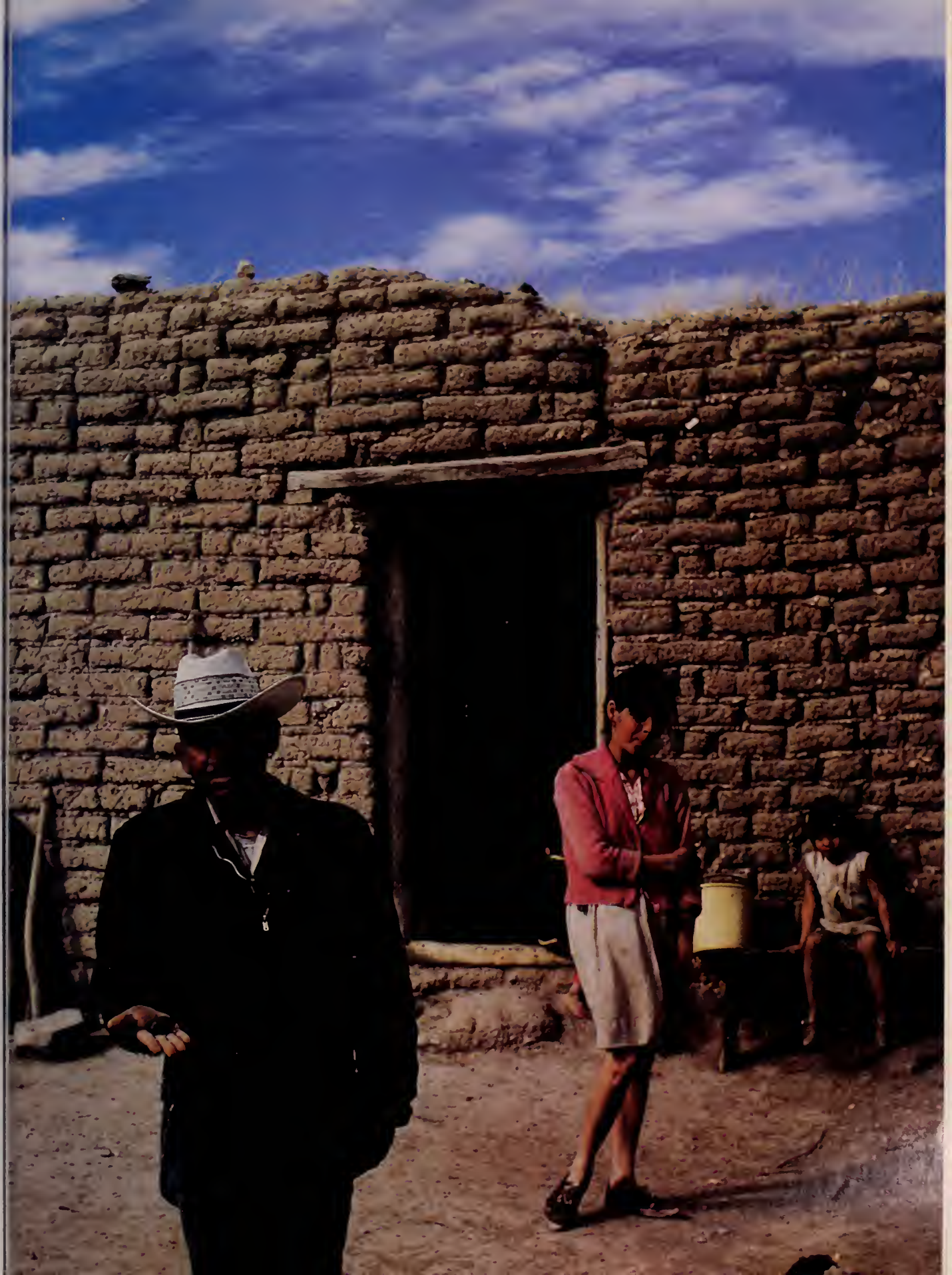
The elements are made in nuclear reactions in the stars. Different elements and different isotopes of the same element are produced in different stars; yet all stable isotopes are found in the solar system. The nuclear products of the stars are ejected into the interstellar medium where they mix together in enormous clouds. In 1969, the prevailing view among cosmochemists was that the solar system formed when such an interstellar cloud of gas and dust underwent gravitational collapse and fragmentation and when one of the fragments continued to collapse into a disk-shaped cloud called the solar nebula. It was thought that during the collapse, gas mixing was thorough enough to erase any preexisting spatial variations in elemental and isotopic composition and that temperatures were high enough in the center of the nebula to evaporate all preexisting interstellar grains. Outer parts of the disk remained cold. The planets in the inner solar system—Mercury, Venus, Earth and its moon, and Mars—were viewed as having accreted from solid materials that condensed in the inner part of the solar nebula when the gas cooled off again. Hence, what minerals condense from a cooling gas of solar composition and in what order are questions of obvious importance to understanding the chemical compositions of the terrestrial planets.

Controlled condensation experiments are difficult to perform at the high temperatures relevant to this problem, but calculations based on the relative stabilities of minerals and gaseous molecules allow detailed predictions that form the basis for discussion of this subject. These models assume that chemical equilibrium was achieved during condensation. (Chemical equilibrium means the tendency of the minerals and gas present at any given time to become as stable as possible.) The models require thermodynamic data for chemical species that can exist in such a system, as well as estimates of the abundances of the elements in the solar system and of pressures and temperatures in the inner solar nebula. Early versions of such calculations predicted that minerals rich in aluminum, calcium, and titanium would be the first-appearing condensates of any of the abundant elements in a cooling gas of solar composition. In 1972, I predicted the sequence in which various minerals would condense under conditions of complete chemical equilibrium.

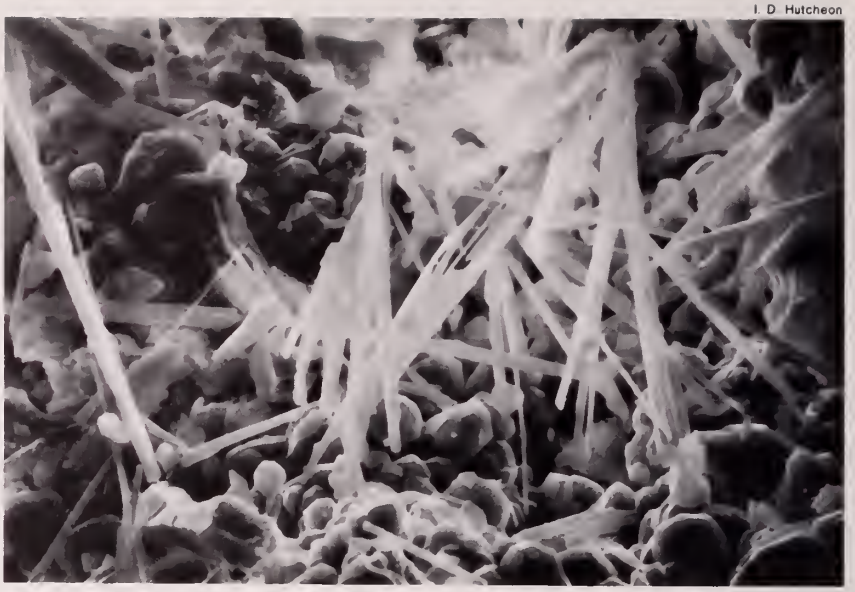
A slab surface of the Allende meteorite shows that the coarse-grained inclusions are prominent because of their large size and light color. Before long, these objects had attracted the attention of the earliest investigators of the meteorite, who discovered that the white inclusions are filled with calcium-, aluminum-, and titanium-rich minerals. The investigators pro-

A piece of the Allende meteorite is exhibited by its finder on February 16, 1969, eight days after the carbonaceous chondrite fell. This photograph was taken in the town of Torreon de Mata, near the southern end of the large area over which the fragments of the meteorite fell.

Roy S. Clarke, Jr.



I. D. Hutcheon



Two types of coarse-grained inclusions—type A and type B—with different mineralogical compositions have been found in the Allende meteorite. Type A, shown here in a scanning electron micrograph, is irregularly shaped. These inclusions may be aggregates of the original solids that condensed from the solar nebula.

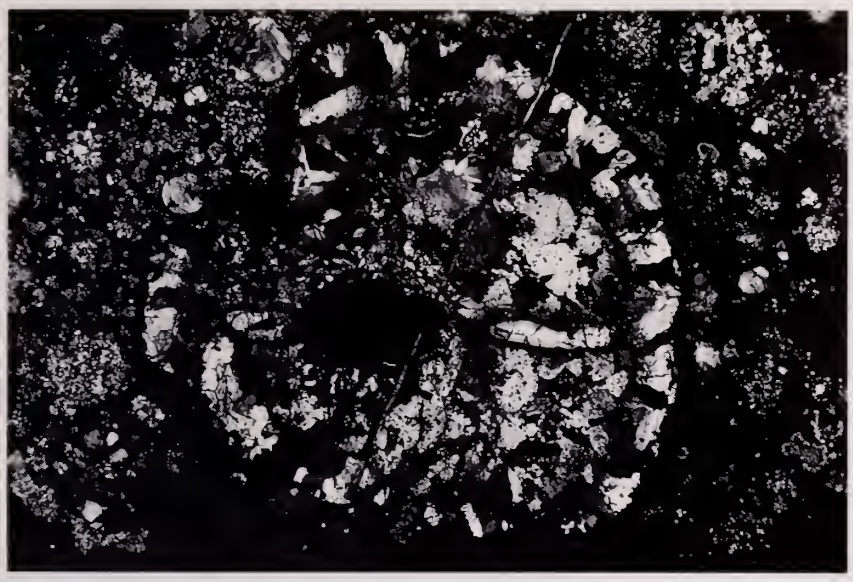
posed, on the basis of this similarity to the minerals that thermodynamic calculations predicted would be the first to condense from a cooling gas of solar composition, that these white inclusions must be high-temperature condensates from the solar nebula.

To study the mineralogy of the inclusions, meteorite pieces containing them are sliced into sections so thin that light passes through. The minerals are then identified by their characteristic colors in a polarizing microscope and analyzed chemically by bombarding the polished surfaces of the sections with electrons. Two kinds of coarse-grained inclusions—type A and type B—with different mineralogical compositions exist. In 1972, I pointed out that, except for one mineral, hibonite, the mineralogical composition of the type A inclusions is precisely the mineral assemblage predicted to be in complete chemical equilibrium with a gas of solar composition in the temperature range 1,175°C to 1,250°C at a total pressure of one-thousandth of an atmosphere, conditions thought to be representative of the inner solar nebula. No thermodynamic data exist for hibonite but it was thought to have condensed first, instead of the mineral corundum predicted by the calculations. Many type A inclusions are irregularly shaped and suggest that, while floating freely in the solar nebula prior to incorporation into the meteorite, they resembled "fluff balls," just what would be expected when small particles strike one another and stick together.

In contrast to fluffy type A inclusions, the type Bs are often nearly spherical, the shape that would be taken by a suspended liquid droplet, and their mineralogical composition is different from the type As. Their coarse crystals are tightly intergrown, a texture typical of materials that crystallized from melts. Some possess outer mantles of the mineral gehlenite, in which it can be shown that the crystals grew from the outer margins of the inclusions inward with falling temperature. This can be readily explained if such inclusions were once molten droplets that cooled and solidified from the outside in by radiating heat away from their surfaces. On the other hand, such inclusions cannot be explained by the condensation of solids from a vapor like the solar nebula, as it is very difficult to see why this would lead to formation of a hollow spherical shell of gehlenite that was filled in by later condensates. Thus, it appears that fluffy type A inclusions could be aggregates of the original solids that condensed from the solar nebula, while many type B inclusions melted either during or after condensation.

Further evidence that both types of coarse-grained inclusions are high-temperature condensates comes from their chemical compositions. Sufficient material can be dug from a single inclusion that it can be analyzed for a large number of elements present in major or trace amounts by a technique known as neutron activation. This technique involves the conversion of stable isotopes into radioactive ones by bombarding the sample with neutrons in a nuclear reactor and then determining the concentrations of elements from the amounts of gamma rays emitted at different energies. Such experiments show that a large number of elements that exhibit a wide range of chemical properties are enriched by the same amount (a factor of 17.5) in the inclusions relative to their abundances in an average sample of solar system matter. Condensation calculations show that the chemically diverse elements analyzed by neutron activation share one characteristic: they all condense from a gas of solar composition above or within the range of condensation temperatures of the major minerals in the inclusions. It must therefore be this common feature that enriched all of these elements to the same degree in the inclusions. Although all refractory elements separated themselves from the rest of solar system matter by forming the inclusions, the fact that the enrichment factors for all these elements are the same indicates that they did not separate from one another in the condensation process.

When viewed in thin section with a polarizing microscope, most inclusions contain dark regions. These areas are filled with many crystals so small that they cannot be resolved under ordinary magnification. This dark material tends to fill veins that crosscut gehlenite crystals, indicating that it formed after the gehlenite. The same dark material also fills cavities on the edges of the gehlenite crystals, suggesting that the material in the



Type B inclusions, as this example photographed with a light microscope shows, are nearly spherical. Their shape and tightly interlocking grains suggest that they were once molten droplets. The mineral around the edges here is gehlenite. Other smaller inclusions are visible in the surrounding matrix.

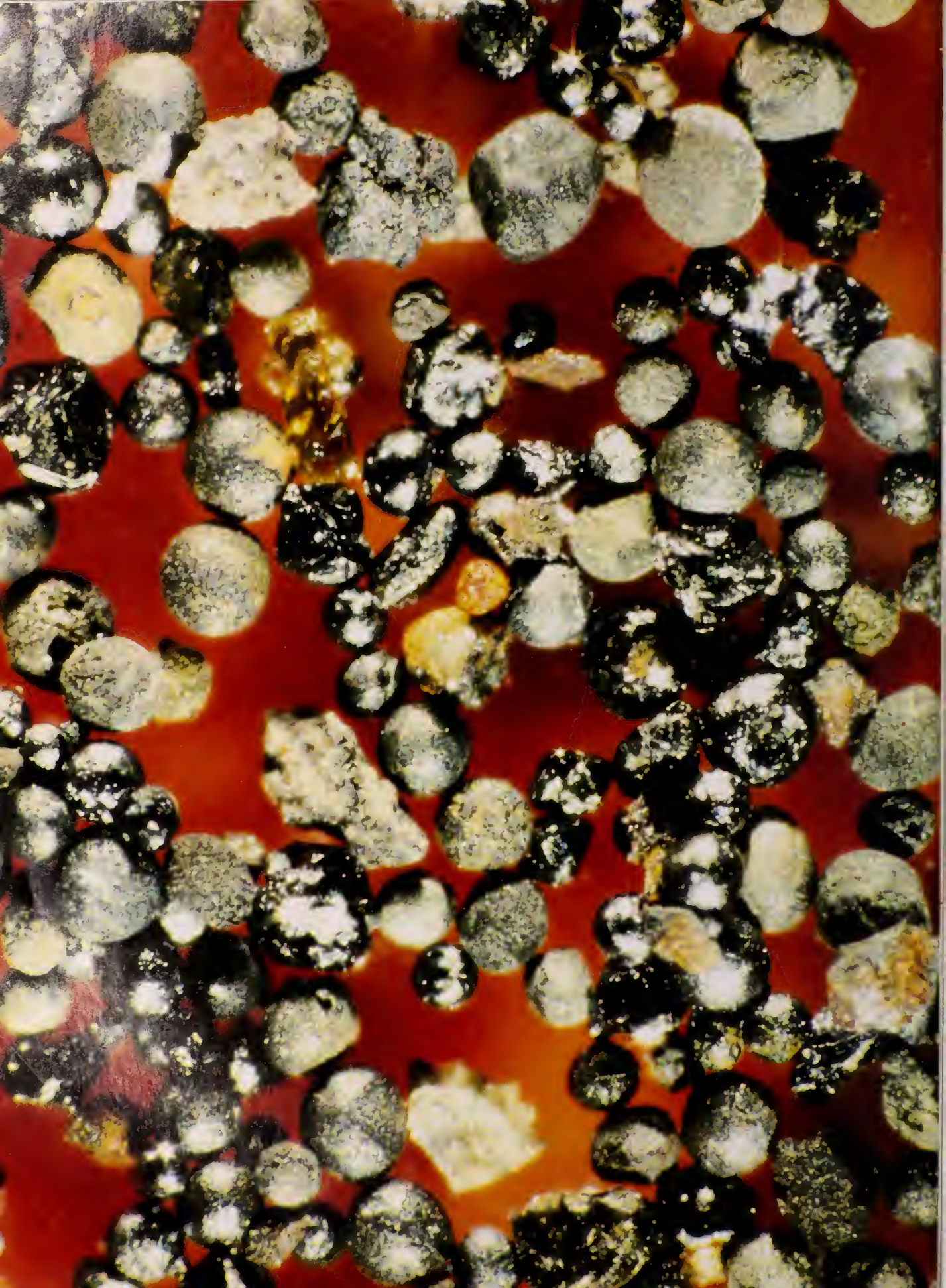
R. S Kjarval

cavities corroded and formed by chemical reaction at the expense of the gehlenite. In order to study the material of the cavities more closely, photographs were taken with a scanning electron microscope and the minerals of that material were identified from the energies of the X-rays emitted by them under electron bombardment. The minerals in the veins and cavities form beautiful, well-developed, multifaced crystals with large amounts of empty space between them. Textures with such empty spaces are usually interpreted as implying crystallization in a gas pocket, a process in which the solid products occupy only a small fraction of the volume of the starting vapor. Although the minerals of these veins and cavities formed by reaction of a previously condensed gehlenite with a gas, none of them are predicted by thermodynamic calculations to condense from a gas of solar composition. One possibility is that the solar nebula differed in chemical composition from place to place and that the Allende inclusions condensed in one region of solar composition but were altered in another area of different composition.

Another indication that the history of the coarse-grained inclusions did not end with the condensation of the major minerals in their interiors is the presence of rim layers around the outsides of these inclusions. Every inclusion is surrounded by the same sequence of four mineralogically distinct rims, each of which is so narrow (three to thirty microns) that a scanning electron microscope is required for its adequate study. The innermost zone is made of typical high-temperature condensates, but the next layer is rich in one of the alteration minerals seen in the veins and that was formed by reaction between the previously condensed minerals and the surrounding nebula. The third layer from the interior of the inclusion consists of another alteration mineral that grades outward in composition to another mineral formed by later condensation. The outermost layer is made of two minerals rich in iron oxide.

The rims have several noteworthy features. Because they are not granular, they cannot have formed by the accretion of grains that crystallized elsewhere, as in sedimentary rocks. Rather, their structure suggests that they crystallized in situ, perhaps by reaction between inclusion interiors and some other material. This reacting material cannot have been minerals in the meteorite matrix in which the inclusions are embedded. The reason is that such a reaction would produce a rim all the way around each inclusion, but sometimes the rims extend only part way around an inclusion even though the matrix completely surrounds the inclusion. Rimming must have occurred prior to the incorporation of the inclusions into the meteorite's parent body, but some rims were broken off between these two events. The rims probably formed in a reaction between the inclusions and the gas of the solar nebula, but some of the reaction products cannot form at chemical equilibrium in a gas of solar composition. Thus, there is once again the possibility that the inclusions were formed in a region of nonsolar composition. The presence of iron oxides in some rim minerals indicates that this region was much more oxidizing than the one from which the interiors of the inclusions condensed because, in it, we know metallic iron was the stable iron-bearing mineral.

In conclusion, we have seen that the Allende meteorite contains objects that crystallized in the cosmic cloud from which the solar system formed. Some are aggregates of mineral grains that condensed directly from the gas of that cloud. These inclusions are our best clues to conditions and processes that occurred in that distant era before the planets formed. Recorded in the inclusions is a rather complex history of successive condensation events and evidence that the cloud was heterogeneous in chemical composition. Data show that the cloud was also isotopically heterogeneous and that collapse of the interstellar cloud to form the solar system may have been triggered by the explosion of a nearby supernova. It seems likely that the inferred spatial heterogeneity of chemical and isotopic composition of the nebula was caused by last-minute injection into the nebula of supernova matter of different composition. Different parts of individual inclusions appear to have reacted with gases of different chemical and isotopic composition, apparently reflecting the fact that the inclusions began forming before newly injected material was thoroughly stirred with the older matter. □



Cosmic Dust

Interplanetary dust particles from comets and asteroids fall by the ton on the earth, where they can be collected and studied

by Donald E. Brownlee

Meteorites can often be found on Antarctic blue-ice fields and near certain large meteorite impact craters after only a few hours of searching, but finding them elsewhere on Earth is an extraordinarily rare experience. Only about a dozen newly fallen meteorites are found each year by the entire global population of four billion people. This apparent rarity, however, applies only to extraterrestrial materials large enough to be noticed with the naked eye. Small cosmic particles as fine as dust are actually very common, and although invisible to the unaided eye they are present everywhere in our daily environment. Each year more than 10,000 tons of extraterrestrial particles smaller than one millimeter in diameter enter the atmosphere and fall to the surface of the earth. For particles of ten-micron size (a micron is 0.001 millimeter, or about one-sixth the diameter of a fine human hair), the flux hitting the earth's surface is one per square meter per day. If you spend an appreciable amount of time outdoors, you will be "hit" by several cosmic particles a week. However, with fall speeds of a centimeter per second and masses of a billionth of a gram, impacts are less than noticeable. These particles are in the air we breathe, the food we eat, and the water we drink. They are ancient, primitive materials that formed during the earliest history of the planetary system and were stored inside comets and asteroids for most of the age of the solar system—about 4.5 billion years.

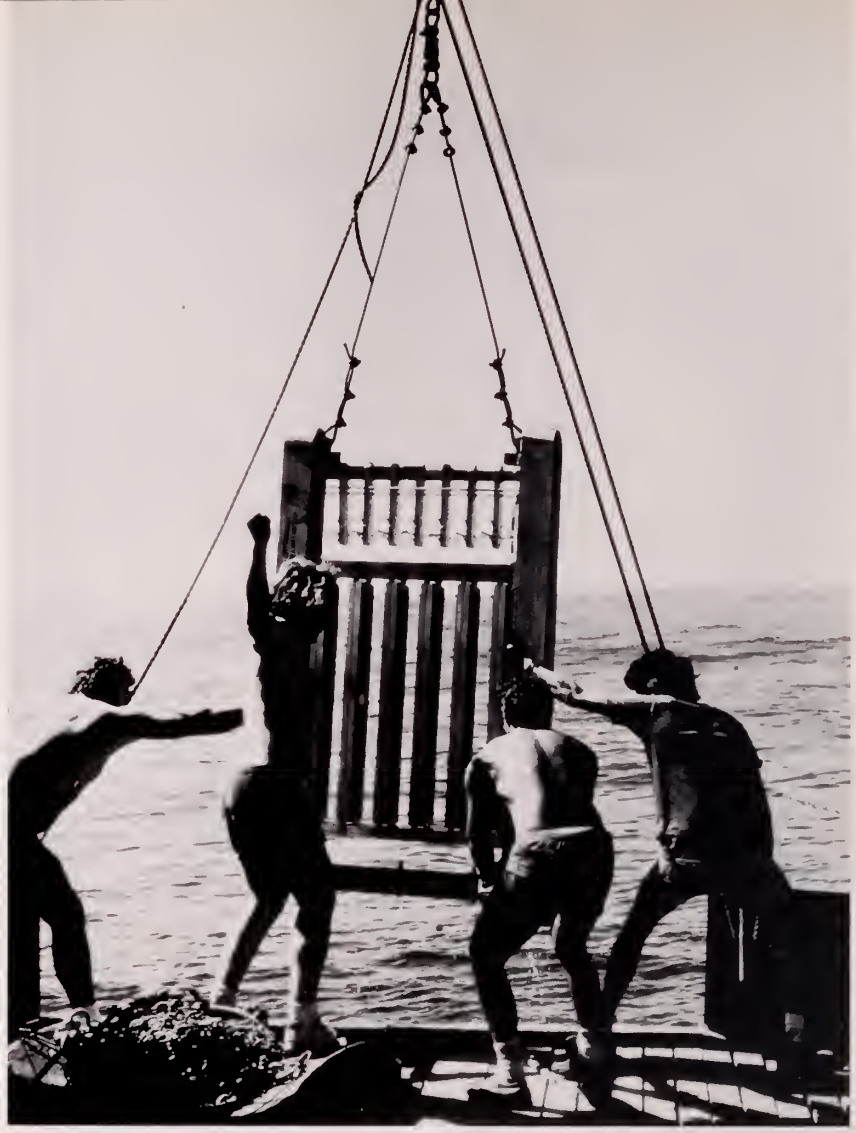
Some of the dust particles are fragments of larger objects that broke up while entering the earth's atmosphere, but the majority are believed to have been small particles of interplanetary dust out in space. Interplanetary dust is material that orbits the sun, forming a giant, flattened cloud centered on the ecliptic—the orbital plane of the planets. This cloud can be seen in the night sky as a faint glow extending along the ecliptic and fading with increasing distance from the sun. The glow is caused by light from the sun scattered off the zodiacal cloud: the vast cloud of dust particles one-micron to one-millimeter in diameter that exists in the solar system.

The interplanetary dust particles that are currently falling into the earth's atmosphere had only a brief existence as small particles in space. Prior to that they were stored inside larger "parent bodies." In almost all cases the parent bodies are comets and asteroids, dusty objects without permanent atmospheres and with low surface gravities. The dust must be generated on a semicontinuous basis because the zodiacal cloud is long-lived in spite of the fact that individual particles are disintegrated by high-velocity collisions with one another on time scales of only 10,000 to 100,000 years. Comets are believed to be the major source of the dust since they are the dominant place of origin of the millimeter-sized particles that produce visible meteors, or shooting stars, in the night sky. From the luminous path of a meteor it is possible to determine the particle's orbital path around the sun, and in most cases the orbits are similar to those of comets. For some annual meteor showers, the meteors can be shown to have originated from specific comets.

All of the cosmic particles on the earth entered the atmosphere at extremely high velocity (greater than twelve kilometers per second) and were subjected to elevated temperatures and, sometimes, extreme mechanical stress as they decelerated. The character of a particle's high-velocity entry into the atmosphere is dependent on its size. Large meteoroids, say larger than ten centimeters, penetrate deeply into the atmosphere at high velocities until they reach altitudes of less than thirty kilometers. There the air density is significant and generates large pressures on the leading edge of the meteoroid, causing its surface to melt and vaporize. Although the surfaces of the big meteoroids melt, their interiors remain cool, much like a baked Alaska. Their interiors may escape strong heating, but the pressures acting on big meteoroids during entry are so great that fragile materials disintegrate and only fairly strong rocks survive intact. This selective process may explain why the majority of recovered meteorites are thought to be asteroid chunks even

Most of the cosmic spheres that accumulate on the sea floor are magnetic, a fortuitous circumstance that facilitates their collection. The spheres in this enlargement were gathered in 1979 in the Pacific Ocean southeast of Hawaii.

Donald E Brownlee



Cosmic Muck Rake is the nickname for this magnetic contrivance devised by researchers at the University of Washington for the collection of cosmic spheres from the sea floor. The rake is usually towed through the water at depths of about five kilometers, picking up tens of thousands of spheres in a day.

Leo Pilachowski

though most meteoroids in space are believed to be of cometary origin and are probably composed of weak and fragile materials.

Fortunately, the strength problem, or the ability of materials to resist pressure, is less severe for dust particles than for large meteoroids. Small particles of less than 100 microns in diameter decelerate from their cosmic velocity of about fifteen kilometers per second high in the atmosphere to speeds of about one centimeter per second near altitudes of one hundred kilometers. There the air is so thin that the maximum pressure generated on the particles is a thousand times smaller than the pressure experienced by bigger objects lower in the atmosphere. The fact that many of the extraterrestrial dust particles that have been collected are more porous and fragile than conventional meteorites is proof that the strength problem is not severe for cosmic dust.

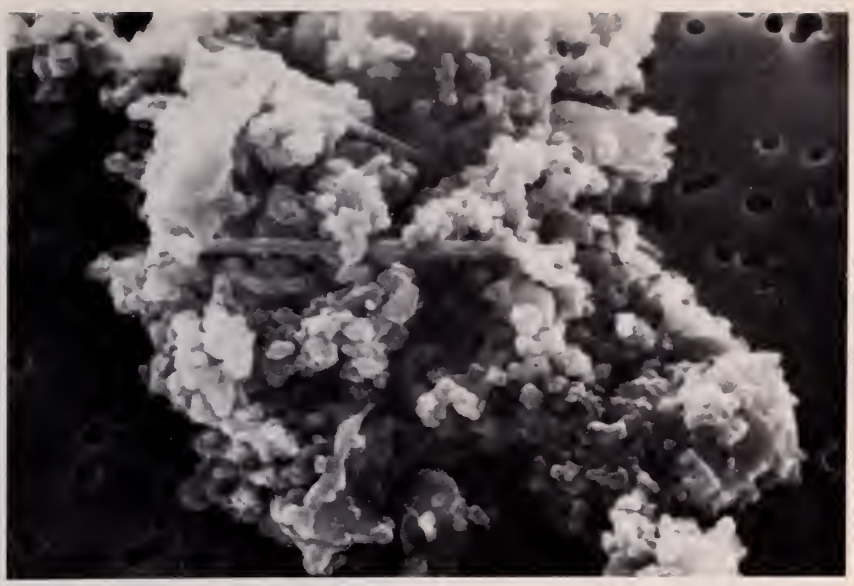
The heating of interplanetary dust as it enters the atmosphere is also a function of size. Most of the particles smaller than fifty microns decelerate in very thin air where the rate of frictional heating is so low that the particles are not heated to their melting points. Dust particles that survive entry without any melting are called "micrometeorites," as defined in the 1950s by the American astronomer Fred Whipple. Most of the particles larger than 100 microns do not slow down until they reach high enough air densities to cause melting. Big particles larger than a few millimeters can have fairly cool interiors even though their exteriors melt, but as they melt, surface tension pulls them into the shape of spheres, and they solidify within a time span of seconds and at very high altitudes. Some rare particles larger than 100 microns can escape melting only if they enter the atmosphere at an oblique angle.

To investigate the true physical nature of interplanetary dust, it is an enormous advantage to capture individual particles that can then be studied in the laboratory. Space would seem to be the obvious place to collect interplanetary dust. Unfortunately, this is impossible to do in a nondestructive way because of the enormously high velocity of the particles relative to any collector that might be put into space. A cosmic dust particle striking a spacecraft decelerates from a velocity of fifteen kilometers per second to zero in only a billionth of a second. The impact vaporizes the particle and a tiny crater (and possibly some debris) is the only remaining evidence that the particle ever existed. With this problem in mind, it is clear that the earth itself is perhaps the ideal cosmic dust collector. In the thin air of the upper atmosphere, incoming particles are decelerated relatively gently, and the "collision" with the earth's atmosphere can be nondestructive.

The problem with the earth is that while it is a good cosmic dust catcher, the actual recovery of individual dust samples for laboratory study is very difficult. Paradoxically, although extraterrestrial dust is everywhere around us in our terrestrial environment, it is almost impossible to find. The situation is different for large meteorites, of course. If a 100-kilogram meteorite fell today in New York City it would almost certainly be found since large rocks falling out of the sky are unusual and conspicuous objects. This is not the case for ten-micron cosmic dust particles. While it is true that on the average a square meter of New York will collect one cosmic dust particle every day, it will also collect up to ten billion other par-

A scanning electron micrograph of a stratospheric dust particle shows that it is composed of large numbers of submicron grains. Particles such as this, collected with a U2 aircraft, are thought to be the most common type of interplanetary dust.

Donald E Brownlee



ticles of similar size. In an optical microscope, the cosmic particles are indistinguishable from the terrestrial particles. In an electron microscope, the chemical compositions of individual particles can be determined, making it possible in principle to identify the single extraterrestrial particle among ten billion contaminants, but in practice that would take centuries of work.

Fortunately, there are better places than cities in which to collect extraterrestrial dust. Two regions where cosmic dust particles can be successfully collected are the stratosphere and the deep-ocean floor. In the stratosphere, at altitudes above twenty kilometers, "large" terrestrial particles are quite rare and most particles bigger than ten microns are not particles that rose from the earth's surface but ones that fell in from space. Large terrestrial particles are scarce in the stratosphere because they are only lifted to high altitudes by such rare events as huge thunderstorms or volcanic explosions, and because of their relatively high fall speeds (a kilometer a day).

The other good collecting locality for extraterrestrial dust is the deep-ocean floor in regions far from continents and islands. The ocean floor may be one of the dirtiest environments on the earth, but it is a place uniquely suited for the recovery of extraterrestrial material. Although cosmic particles that fall onto the sea floor are greatly diluted with terrestrial materials, they are less diluted than those recovered anywhere else on Earth. In the center of the Pacific Ocean, the accumulation of sediments from the continents, for example, is only a few meters in a million years. A cubic meter of sea-floor mud, then, contains all of the extraterrestrial particles that fall onto a square meter of surface area in a period of nearly 500,000 years. The long accumulation time of deep-sea sediments makes it possible to obtain samples of much rarer and therefore much larger particles than can be collected in the stratosphere.

The "trick" in collecting cosmic material from deep-sea sediments is that most of the extraterrestrial particles in the 0.1 millimeter to 1 millimeter size range are magnetic, a property that distinguishes them from nearly all other particles of similar size on the sea floor. The magnetic mineral magnetite forms in most meteoritic materials that are melted or heated to high temperatures in the atmosphere. For example, the fusion crusts of stony meteorites are magnetic even though their unmelted interiors may be nonmagnetic. Because of their magnetic property, the larger dust particles can be easily extracted from deep-sea sediments by means of simple magnets.

The first positively identified extraterrestrial particles collected in the atmosphere were obtained in 1970 with a University of Washington high-altitude balloon experiment called the Vacuum Monster. At the present time, particles are routinely collected in the stratosphere with NASA U2 aircraft flown from Ames Research Center in California. The U2 carries a small pylon underneath its wing that exposes a sticky flyswatter-sized collection plate to the airstream. After exposure on ten or fifteen consecutive flights the collection plate is removed to a clean room, where individual particles are picked off with tiny glass needles and mounted for study in analytical electron microscopes and other instruments.

The extraterrestrial particles are a fairly large fraction of all the collected particles larger than a few microns and identification is not usually a problem. Most of the cosmic particles have elemental compositions similar to primitive meteorites and are distinctly different from nearly all terrestrial contaminants. The most common contaminants are pure aluminum oxide (sapphire) spheres, which are the combustion products of solid fuel rockets. The proof that the particles identified as cosmic are indeed extraterrestrial came from the detection of helium and other rare gases implanted in them by the solar wind. The rare-gas content is high, comparable to that in lunar soil, and is undoubtedly the result of implantation of the ions composing the solar wind while the particles were in space.

Most of the 500 extraterrestrial particles that have been collected in the stratosphere are true micrometeorites —dust particles that have survived entry into the atmosphere without melting. They are small, less than fifty microns in diameter, exceedingly rare, and difficult to collect. The collection of a single ten-micron particle requires sampling more than a thousand cubic meters of stratospheric air. Particles larger than 100 microns are so rare



In this scanning electronmicrograph, the surface of a stony deep-sea sphere, etched by ocean water, reveals crystals of different minerals.

Donald E Brownlee

that collection of a significant number of them from the atmosphere is beyond our present ability. The way to collect these larger dust particles is not to try to capture them before they hit the ground, but to find some region on the earth where they accumulate over a fairly long period with a minimum of terrestrial contamination. The best such place is the sea floor.

Because of the relative ease of recovery and the durability of large particles in sea-floor sediments, most of the cosmic particles from that source are in the range of fifty microns to a few millimeters. The majority of these particles melted during entry into the atmosphere, forming small round bodies commonly called cosmic spheres. True unmelted micrometeorites must exist in ocean sediments but they are probably not very magnetic, and because of their contact with mud and water, they would be in much less pristine condition than those collected in the atmosphere. The sea floor is the best collection site for large melted cosmic spheres, but the smaller true micrometeorites are best collected in the stratosphere despite the difficulties involved.

Cosmic deep-sea spheres are highly degraded samples of interplanetary dust that were melted in the atmosphere and later at least partially modified chemically in the ocean. They are valuable because they are relatively large. A one-millimeter sphere contains a million times more mass than a ten-micron particle. The larger size is a great advantage when attempting to measure trace elements in the material or when trying to determine the isotopic composition of stable elements such as oxygen or of radioactive isotopes such as manganese 53, produced by cosmic-ray bombardment in space. Many of the valuable measurements require spheres a millimeter in diameter but spheres of this size are so unusual that only a few can be found in a ton of sediment.

The first cosmic spheres were found more than a century ago when scientists on the British *Challenger* expedition in the 1870s ran a hand magnet though mud samples recovered from the sea floor. They found curious spheres, some of which contained metallic iron. Metallic iron is very rare in nature, and the researchers correctly concluded that the particles were extraterrestrial.

To collect large particles without bringing tons of mud into the laboratory the sensible approach is to do the magnetic separation in situ on the ocean floor. This was first done in the 1950s by Danish oceanographers using magnets mounted in a wooden plank that was dragged along the sea floor at several locations around the world. This technique was recently improved on by University of Washington researchers who used a 300-kilogram magnetic collection device, something like a sled, called the Cosmic Muck Rake. The collection sled was towed in the Pacific Ocean at a depth of 5,300 meters by the University of Hawaii research vessel *Kana Keoki*, and tens of thousands of cosmic spheres, ranging in size up to three millimeters, were collected.

Studies of the deep-sea cosmic spheres made by an international group of investigators have concentrated on elemental and isotopic composition because most of the other properties of these particles were destroyed by melting during atmospheric entry. The compositions of the spheres fall into two basic groups: type I (for iron), composed of metallic iron and magnetite; and type S (for stony), composed of silicates and magnetite. Since the origin of the type I spheres remains unknown, it is not clear whether the parent materials are pure iron meteoroids or stony bodies that contain metallic iron. The elemental compositions of the type S spheres indicate that approximately 80 percent of them are solidified droplets of a material similar in composition to the carbonaceous chondrites but different from the ordinary stony meteorites. This is noteworthy because only 2.5 percent of freshly fallen meteorites that are larger than dust size are of the primitive carbon-rich variety. Apparently, carbonaceous chondritelike objects are more common in space than their scarcity in meteorite collections would suggest. The cosmic spheres are probably a more representative sample of the millimeter-size objects in space than normal meteorites are of the bigger objects. All materials presumably melt and form spheres, but only fairly strong materials become traditional meteorites.

Studies of micrometeorites collected with U2 aircraft reveal detailed information on interplanetary dust because these samples are the least altered by atmospheric entry. Extensive investigation with optical and electron microscopes has shown that the most



This crater in a lunar rock was created by a high-velocity cosmic dust particle striking the moon. The crater was discovered when the rock sample was viewed with a scanning electron microscope.

Donald E Brownlee

common interplanetary dust particles are black aggregates of tiny grains of submicron size, smaller than the wavelength of light. A single ten-micron particle is actually a collection of nearly a million grains ranging in size from several microns down to 100 angstroms or less. (Angstroms are used to measure the wavelengths of light and intermolecular distances. One angstrom equals one ten-thousandth of a micron.) The individual grains are usually iron-magnesium silicates or iron sulfides. Some of the submicron grains themselves are aggregates of carbonaceous materials and tiny crystalline silicates. The bulk elemental compositions of the aggregates are similar to carbon-rich meteorites, yet the structure and to some extent the mineralogy of the particles are different from those of established meteorite types. Many of the particles are fragile, and some are porous, forming weakly bonded structures that resemble bunches of grapes. The material that makes up the most common type of interplanetary dust has not been found in the bigger meteorites, presumably because it cannot survive entry into the earth's atmosphere in large pieces.

In addition to the aggregates of submicron particles, a variety of other types of micrometeorites from the stratosphere have been studied. Some of these particles are single crystals of silicate minerals or iron sulfides that are coated with a thin micropowder of material identical to the fine-grained material that composes the aggregates. These particles were probably embedded in the aggregate material at one time but were broken out either by processes that occurred in space or during atmospheric entry. Other types of particles have more mysterious origins. These types include crystals of metallic nickel-iron, particles composed of carbonates or phosphates, particles composed of stacks of iron-sulfide platelets, and particles composed of glass spheres coated with tiny mounds of metallic nickel-iron.

Laboratory studies of micrometeorites and cosmic deep-sea spheres indicate that most interplanetary dust particles are primitive, complex materials that are often more fragile and porous than meteorites. While the origin of these extraterrestrial particles is not certain, it is probable that they are samples of comet dust. The most porous particles are so fragile that their mere existence may be inconsistent with their ever having been inside a pure rocky body such as an asteroid. If the particles are comet dust, they may be samples of the building materials of the giant outer planets preserved at low temperatures ever since the formation of the solar system. Comets are unique bodies composed of dust and ice that accumulated in the cold outer regions of the primordial solar nebula. The dust contained in comets is expected to be well preserved because comets are cold objects that have never been warm and have spent most of their lifetime at great distances from the sun. The typical solar system comet has a surface temperature only a few tens of degrees above absolute zero and exists so far from the sun that the sun viewed from a comet would be just a small star in the sky, only a little brighter than Sirius, the brightest star visible from the earth.

The truly exciting aspect of comet dust is the possibility that it might be older than the solar system itself. The solar system was formed from interstellar gas and dust; in the cold regions where the comets formed, some ancient presolar system grains may have survived with minimal alteration. The aggregate interplanetary dust particles may be collections of these grains. In that case, the study of interplanetary dust particles may not only give us information about comets and how solid bodies formed in the solar nebula but it may also give us direct, detailed information about environments elsewhere in our Galaxy. The comet dust that falls on you each week may contain a little stardust, perhaps as old as the Galaxy itself. □

Heaven's Habitués

"On the sixteenth of November, 1492, a singular miracle happened: for between eleven and twelve in the forenoon, with a loud crash of thunder and a prolonged noise heard afar off, there fell in the town of Ensisheim a stone weighing 260 pounds. It was seen by a child to strike the ground in a field near the canton called Gisguad, where it made a hole more than five feet deep. It was taken to the church as being a miraculous object. The noise was heard so distinctly at Lucerne, Villing, and many other places, that in each of them it was thought that some houses had fallen. King Maximilian, who was then at Ensisheim, had the stone carried to the castle; after breaking off two pieces, one for the Duke Sigismund of Austria and the other for himself, he . . . ordered that the stone be suspended in the parish church."

From a document in the town archives, Ensisheim, Germany

"The meteorite appeared as a ball of fire in the west September 2, 1905, at ten o'clock in the evening, the sky being cloudless and the clear atmosphere of the plains being undisturbed by wind. From Scott City to Syracuse, 75 miles southwest, it was light enough to read common newspaper print on the street and the explosions rattled doors and windows. The mass exploded, and then the resulting fragments exploded several times in rapid succession. Then came the sounds of the explosions, the whistling like bullets or heavy hail of the smaller fragments and a most intense humming like that of a rapidly revolving cylinder of some heavy machine, evidently caused by the larger mass. This was followed by fierce cannonading (echoes of the explosions?) like the discharge of a battery of artillery or a rapid-fire machine gun, gradually growing fainter and dying out like rolling thunder in the distance. I heard the largest one drop and hunted for it for over two years.

"On May 6, 1908, I was breaking new ground on the prairie with a gang plow and a five-horse team that was a little too high-spirited to be controlled easily, but having half-mile furrows as smooth as a lawn before me, I had set the plow a few notches deeper into the ground and let them go, thinking nothing of meteorites. While congratulating myself upon our speed we suddenly—very suddenly—struck something hard. It threw me out of my seat and piled my gang plow up in a promiscuous heap against the team, which was too badly surprised to do anything. I commenced stabbing with my jackknife and soon located the cause of the disturbance. It was the largest fragment of the Modoc meteorite and completely buried under the tough buffalo sod (virgin soil) and was pounded in so hard that the force of the blow of my gang plow had not loosened it. So completely was it buried, that I had hunted dozens of times all over that pasture without either finding the rock or the hole in the ground which it had made."

J.K. Freed, Modoc, Kansas

"[On October 17, 1921, at 11:00 P.M.] I saw it very light out of doors and heard a roaring sound and then



A one-hundred-ton crane was needed to lift Ahnighito. AMNH

STAR & SKY HAWAII/ ECLIPSE CRUISE



Sail into the path of totality -in the North Pacific- on July 30, 1981!

On February 26, 1979, millions of Americans watched as the moon's disc covered the sun, producing nature's superspectacular – a total solar eclipse. But the celestial clockwork has ordained that America will not be placed under the moon's shadow again for 36 years. Last year eclipse-chasers travelled to Africa and India to see the spectacle. Since total solar eclipses can be witnessed somewhere on Earth about once a year, we decided to sail into the path of totality in the North Pacific on July 30th.

Be among the special group of people who will view a total solar eclipse from the decks of a 30,000-ton 682-foot luxury liner at sea. ***Star & Sky Expeditions*** has contracted the SS Oceanic Independence, of American registry, for the sole purpose of seeking the awesome darkness at midday.

The 14-day cruise includes the voyage to and from the eclipse site, approximately 1200 miles northwest of Honolulu. ***This location has better than an 80% chance of clear skies – SUBSTANTIALLY BETTER THAN ANY OTHER LOCATION ALONG THE PATH OF TOTALITY.***

The eclipse-viewing will be followed by a ***5-day Hawaiian Island cruise,*** making ports-of-call on the islands of Kauai, Maui, Hawaii, and Oahu.

Our scientific staff is the finest ever assembled for an eclipse cruise: ***Bart Bok,*** formerly professor of physics, Univ. of Ariz., and director, Steward Observatory. ***John Eddy,*** senior scientist, High Altitude Observatory, Boulder, Colo., and solar expert and author. ***William J. Kaufmann,*** adjunct professor of physics, San Diego University, and author of nine books on astronomy and relativity. ***James Sadler,*** head meteorologist, Univ. of Hawaii. ***George Keene,*** senior engineer, Eastman Kodak, and astrophotography expert. ***Terence Dickinson,*** editor, *Star & Sky*. Our cruise director is ***Robert T. Little,*** Field Sales Manager for Criterion Scientific Instruments, veteran of three eclipse cruises and seven Astronomy Island cruises to Bermuda, pioneer of solar-eclipse photography at sea.

Space for this incredible eclipse cruise is limited so you must act now. Prices start at $2,000 per person, double occupancy, plus airfare. Detailed information is available in our brochure which can be obtained, along with a free copy of our 1980 eclipse issue, by writing to:

Star & Sky Expeditions, Inc.
44 Church Lane
Westport, CT 06880



In a less hurried time American houses were shaped by Craftsmen who knew and loved the materials of their trade.

A few still are.
American Timber



Cathedral ceilings and exposed wood beams

Northern white cedar—superior insulation and virtually maintenance free

Strong, solid Timber Truss Construction

Energy saving construction cuts your fuel bills up to 70%

American Timber Department 571 Escanaba, Michigan 49829

Custom Cedar Homes
Solar Homes

(906) 786-4550

Custom design your own home with the aid of our architectural staff.

☐ Enclosed is $5.00—Please send me a copy of your Plan Book

☐ Mr. ☐ Ms ☐ Dr. _____

Address _____

City _____ State _____

Zip _____ Phone _____

Construction site _____

three loud explosions. I thought it was an airship and it was dropping some bombs or something of that character. I jumped up and ran to the door, and the big light was disappearing in the south. The roaring itself was not so very loud, but the explosions were very loud indeed, and while I stood in the doorway watching the disappearing light, I distinctly heard a sound like fine singing."

Mrs. George Hall,
Rose City, Michigan

These three eyewitness accounts of meteorite falls have one thing in common: they all describe meteorites that ended up in the collection of the American Museum of Natural History. Along with hundreds of others— each with a fascinating story to tell—the three meteorite fragments will be on display in the Museum's new Arthur Ross Hall of Meteorites, scheduled to open April 30.

The Museum's meteorite collection, one of the finest in the world, includes pieces from half of all known meteorites. The new permanent hall will exhibit a piece from the oldest documented fall, a meteorite studded with tiny diamonds, microscopic meteorites, hundreds of strange little blobs of glass known as tektites, three moon rocks, and much more.

The largest meteorite in captivity—the second largest known—dominates the center of the octagonal hall. Called the Ahnighito or the Tent, this 62,085-pound chunk of nickel-iron rests on six massive steel pillars embedded in the bedrock beneath the Museum. Flanking the Ahnighito are two lesser companions, the Woman and the Dog. All three are fragments from a 200-ton fireball that exploded over Greenland about 10,000 years ago, scattering its remains across an ice sheet.

The three chunks were discovered, possibly eight centuries ago, by Eskimos, who hammered off pieces of iron to make knives and spears. In 1894 Adm. Robert E. Peary, following up rumors of an "iron mountain," located them with the help of an Eskimo guide. Peary managed to excavate the meteorites, move them from their resting place near Cape York, Greenland, to his ship *The Hope,* and transport them to New York. While Peary was on his way to the North Pole in 1906, Mrs. Peary, acting as his agent, sold them to the Museum. She explained



A block-long team of horses hauled Ahnighito to the Museum in 1906.

her reasons in a letter to Morris K. Jesup, president of the Museum: "The meteorites are all I have and I feel that I should make an effort to turn them into money and invest it so that my children will have something with which they can be educated and fitted to earn their living.... Mrs. Jesup would scold me for bothering you but what can I do?... I have come to the conclusion that it is much easier to go to the Arctic and do the thing you are interested in and want to do than it is to stay at home, bring up the children, fight your husband's battles and look out for bread and butter for the family. I think hereafter I will do the exploring and let Mr. Peary take care of the home life."

After bargaining for several years, Mrs. Peary and the Museum agreed on a price of $40,000. It is interesting to note that, in 1979, moving the three meteorites from the Planetarium to the new hall—a distance of a few hundred yards—cost the Museum more than $100,000.

The new hall is the best of several meteorite halls in the Museum's history, thanks to the generosity of Arthur Ross, a Museum trustee, and the expertise of Martin Prinz, curator of



AMNH

Celestron®



For the photographer, astronomer, naturalist, educator, or casual observer — Celestron has established a new standard in superb telescopes and telephoto lenses at affordable prices (from $295). All feature large observatory mirror/lens type optics folded into a compact, lightweight, portable telescope or telephoto lens. Close-up detail borders on the fabulous from celestial objects light years away, to ships, planes, flowers, wildlife or people. Here is truly an instrument that allows you to observe or photograph the world around you. Celestron also has a full line of binoculars of astronomical quality.



Send $2.00 for 32-page full color catalog on how to select and use a Celestron telescope or telephoto lens.

Celestron International
2835 Columbia St., Box 3578-NH
Torrance, Calif. 90503, U.S.A.
Telephone: (213) 328-9560

(Dealer Inquiries invited.)



Voyager has done it again! We now have two beautiful full-color posters of everyone's favorite planet, Saturn! One shows only Saturn, the other is a montage showing the ringed planet and six of its moons

We are also offering a set of ten slides from the Voyager-Saturn encounter

☐ **Enclosed is $4.50 prepaid for both posters.**
☐ **Enclosed is $5.00 prepaid for set of 10 slides.**

Add $1 00 for our complete catalogs
Foreign orders add $1 00 postage

DEPT. NH

Hansen Planetarium
15 South State Street
Salt Lake City, Utah 84111



The Easy-Rolling Garden Way Cart

We guarantee OUR big, strong Carts will simplify YOUR outdoor chores. Precise axle placement and giant, easy-rolling wheels balance the heaviest...and bulkiest loads -- UP TO 400 POUNDS -- without back or muscle strain. And because it carries 10 TIMES THE LOAD OF A WHEELBARROW you'll finish chores in a fraction of the time. This gives you TIME TO RELAX -- TIME TO ENJOY... your home...family...friends.

Garden Way Research, Dept. A1091C, Charlotte, VT 05445

— *YES!* Please Send *FREE* —
24 Page Cart Booklet
Garden Way Research
Dept A1091C Charlotte VT 05445
(Please Print Clearly)
Name_____
Address_____
City_____
State_____ Zip _____

the hall. "Meteorites," says Prinz, who is also chairman of the Department of Mineral Sciences, "are the Rosetta Stones of the origin of the solar system and planets. In order to understand the planets—including the earth—we have to study meteorites." The hall, Prinz explained, will tell the story of meteorites: Where do they come from? What happens when they hit? What are they made of? What can they tell us about the birth of our solar system?

In the new hall, illustrations, photographs, colorful graphics, and the meteorites themselves will give Museum visitors a dynamic picture of the latest knowledge about these objects from outer space. The power of meteoritic impacts is brought to life on a five-foot video screen; visitors, for example, can watch film footage from the first expedition to investigate

A major symposium, **Meteorites and Planets**, will mark the opening of the Arthur Ross Hall of Meteorites. On Wednesday, April 29, in the Auditorium, leading authorities on meteorites, the planets, and the solar system will discuss their research and the tremendous growth of knowledge about meteorites and the solar system since men first landed on the moon. The Special Supplement in this issue of *Natural History* includes articles by three symposium speakers.

The symposium will be presented at a nontechnical level for the general public. Speakers will consider such questions as: What can meteorites tell us about the origin of the solar system? How do planets form and melt? What happens when meteorites hit? Did they play a role in the extinction of the dinosaurs? What are meteorites made of? The cost of the symposium is $3 for Museum members and students, and $5 for nonmembers. All those attending the symposium will have an opportunity to preview the new hall.

A complete schedule of symposium events appears below:

1:30 P.M. *Introductory Remarks.* Martin Prinz, chairman of the Department of Mineral Sciences; Thomas D. Nicholson, director of the Museum; Arthur Ross, Museum trustee.
1:45 P.M. *The Birth of Planetology.* John Wood, Smithsonian Astrophysical Observatory and Harvard University (see page 56).
2:20 P.M. *Meteorites as Rosetta Stones for Planetology.* Lawrence Grossman, University of Chicago (see page 68).
3:15 P.M. *Meteorites Falling Everywhere.* Donald Brownlee, University of Washington and California Institute of Technology (see page 72).
3:30 P.M. *Where Do Meteorites Come From?* Clark R. Chapman, Planetary Science Institute, Tucson, Arizona.
4:25 P.M. *The Sky is Falling.* Eugene Shoemaker, California Institute of Technology and U.S. Geological Survey, Flagstaff.
4:50 P.M. *Question Period.*
5:15 to 7:00 P.M. *Preview of the Arthur Ross Hall of Meteorites.*
(Dinner break)
7:00 P.M. *Ancient Meteorites, Planetary Beginnings, and Pandora's Box.* Gerald J. Wasserburg, California Institute of Technology.
7:45 P.M. *Question Period.*
7:50 P.M. *A Grand Tour of the Planets.* Ronald Greeley, Arizona State University.
8:35 P.M. *Question Period.*
8:40 P.M. *Where Do We Go From Here?* Noel Hinners, director, National Air and Space Museum.
9:10 P.M. *Question Period.*

Jane Goodall Lecture

Celebrated primatologist Jane Goodall will give a lecture at the Museum entitled *The Chimpanzee: Portrait of the Best-known Ape.* Using slides and film, she will discuss her research with the chimpanzee population of the Gombe Stream Reserve in Tanzania. Her project, now in its twentieth year, is one of the longest continuous studies of a wild animal population ever undertaken. Goodall has witnessed family quarrels, reconciliations, the rise of dominant males, and the splintering of a chimpanzee community. *The Chimpanzee* is being presented by the Membership Office on Wednesday, May 13, at 7:30 P.M. in the Auditorium. Tickets cost $4.50 for members, $7.50 for nonmembers. Associate members may order one ticket at the members' price; participating and donor members may order up to four. Send checks to Jane Goodall Lecture, Membership Office.

Asian Dance

Modern and traditional dances of China, Japan, the Philippines, Tahiti, and other Far Eastern cultures will be presented by the Asian-American Dance Theater. This free Education Department program will take place in the Auditorium on Sunday, April 5, at 2:00 P.M.

Alvin Ailey Repertory Ensemble

The acclaimed Alvin Ailey Repertory Ensemble will give a free dance concert in the Museum Auditorium on Wednesday, April 15, at 7:30 P.M. The concert is sponsored by the Education Department and free tickets will be distributed beginning at 5:30 P.M. at the first-floor Information Desk.

the Tunguska explosion that devastated the Siberian landscape in 1908.

"Meteorites are at the heart of many questions about the planets, the solar system, and even life on Earth," says Prinz. "We hope to look at these questions in a dynamic and interesting way, reflecting the tremendous growth in our knowledge since men landed on the moon in 1969."

Douglas J. Preston

Native American Verse

A reading of Native American poetry will be held on Wednesday, April 29, at 7:00 P.M. in the People Center. This free event is part of a three-program series entitled *Version of the Traditional*, arranged by the Education Department.

To the Raptors

The April membership program, *Birds of Prey*, will look at the raptors—eagles, hawks, and owls. Bill Robinson, director of the Raptor Rehabilitation and Research Center, will show slides and a short film and discuss the life histories, habitats, and adaptations of these birds. Several live birds will also make an appearance. *Birds of Prey* is free for members, $3 for nonmembers, and will take place on Sunday, April 12, at 1:00 P.M. (for children under age 7) and again at 3:00 P.M. (for all ages).

Growing Better

Forever Young, a new documentary film by Robin Lehman, will be shown in the Auditorium on Sunday, May 3, at 2:00 P.M. The film looks at successful aging in America, focusing on people over 65, who talk about what growing old means to them. This Education Department program is free.

Southeast Asia Month

The performing arts of Southeast Asia are the special programs in the People Center this month. Featured every weekend from 1:00 to 4:30 P.M. will be the dance, folklore, and music of Indonesia, Thailand, and Malaysia. A few examples of the many programs offered are *Balinese Dance*, *Folklore and Dance of West Java*, and *Music of Indonesia*. The free People Center weekends are sponsored by the Education Department.

For more information about any programs listed in this section, write to the appropriate department at the American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024, or call
Membership Programs: (212) 873-1327
Education Department: (212) 873-7507
Planetarium: (212) 873-1300, ext. 389

Get the Lion's share!

High Yields. Plus

Daily dividends!
Daily compounding!
Daily liquidity!

You get all this when you invest in Dreyfus Liquid Assets, the high yielding money market fund:

Dividends are declared and compounded daily. You get free checks for cash as you need it, or to pay larger bills. And you keep on earning today's high money market yields until your redemption check clears.

There is no sales charge, there's no penalty for early withdrawals--you can even redeem your investment by phone. Start with just $2,500. Additions can be as low as $100.

Learn how you can get the Lion's share of today's money market rates. Send coupon or call today.

Dreyfus Liquid Assets---

For more complete information, including management fee charges and expenses, obtain a prospectus by sending this coupon. Read it carefully before you invest or send money.

Name _____
Address _____
City _____
State _____ Zip _____
2260107

Post Office Box 600
Middlesex, NJ 08846
FOR A PROSPECTUS
Call toll free, day or night, 7 days a week
1-800-345-8501
Extension 433
In Pennsylvania
1-800-662-5180
Extension 433
0423

THE MARKET

Art

AMERICAN INDIAN CRAFTS: Pueblo pottery; Hopi 2nd and 3rd Mesa plaques; Kachinas; old and new rugs. No catalogue. One-of-a-kind pieces; individually photographed. Most priced $100/up. Write for photos and data, specifying interests. Box 5896, Sherman Oaks, CA 91413 (213) 789-2559.

BALINESE DANCE MASKS, handcarved, handpainted, 6"-8", $30.00, request photos, McCoy Imports, Liberty, NY 12754

ENGLISH WILD FLOWERS, Original water color drawings, dated 1850's, each different, perfect for framing. $15: 2 for $24. Kirschner, 90-59 56 Avenue, Elmhurst, NY 11373

OLD NATURAL HISTORY PRINTS—Catesby, Edwards, Audubon, Gould's Hummingbirds; shells, botanicals, animals, insects, etc. Free illustrated catalogue. Portobello Prints, 1649 Hopkins, Berkeley, CA 94707 (415) 549-1676

PHOTOGRAPHS—SIGNED LIMITED EDITIONS. Kertesz, Levitt, other contemporaries. B&W. From $90. Free Brochure. Photographs For The Collector, Box 432N, Chappaqua, NY 10514

PRE-COLUMBIA ART. Quality items, moderately priced (most $100-$800). Free list. E. Prochownik, 804 Centre Street, Boston, MA 02130

WHALES—hand-carved pine; blue, humpback, sperm, narwhal. Illustrated brochure $1.00. Doug Lind, P.O. Box 74, Burlington, WI 53105

Back Numbers

NATIONAL GEOGRAPHICS, 1888 - 1980, Issues, Book Publications, Collectors Items. Send Wants. Buxbaum Geographics, Box 465-NH, Wilmington, DE 19899

Book Publishers

PUBLISH YOUR BOOK! Join our successful authors. Publicity, advertising, beautiful books. All subjects invited. Send for fact-filled booklet and free manuscript report. Carlton Press, Dept. NHD, 84 Fifth Avenue, New York 10011

Books

BE A SPARETIME TRAVEL AGENT. Detailed guidebook explains how, profits, travel benefits, $3.95, SAV Travel, Box 571-NH, Hicksville, NY 11802

BOOKFINDING. Librarians search worldwide titles or subjects plus 150,000 indexed stock. PAB, 2918 Atlantic, Atlantic City, NJ 08401 (609) 344-1943

CARTOON HISTORY OF THE UNIVERSE. Superb, factual comic series. Volumes One through Five, $1.75 each or $7 the set. Quality paperback of Vols. 1 and 2, $7.50. ROP Inc., P.O. Box 14158, Dept. M17, San Francisco, CA 94114

OUT-OF-PRINT, SCARCE, Zoology, Botany, Ornithology, Colorplate, etc. Catalogue $1.00. Book Chest, 19 Oxford Place, Rockville Centre, NY 11570

PUBLISHERS' OVERSTOCKS, BARGAIN BOOKS. 2,000 titles, all subjects! Free catalogue: Hamilton, 98-55 Clapboard, Danbury, CT 06810

SOUTH AMERICA BOUND? We've got detailed guidebooks, maps for travellers. Europe, Asia too. Send for free catalogue. Bradt Enterprises, 54-N Dudley, Cambridge, MA 02140

SUPPORT THE LIFESAVING MOVEMENT. Read "Lifeguarding Simplified" by Richard D. Baker. Published 1980 by A.S. Barnes & Co., Inc.

YESTERDAY'S BOOKS LOCATED, no obligation. Out-of-State Book Service, Box 3253J, San Clemente, CA 92672 (714) 492-2976

Correspondence

"EARTH FRIENDS" directory interconnects nature-lovers USA-worldwide for friendship, joint-ventures. Free details. Box 331499, Miami, FL 33133

MAKE FRIENDS WORLDWIDE through international correspondence. Illustrated brochure free! Hermes-Verlag, Box 110660/NH, D-1000 Berlin 11, West Germany

ORIENTAL WOMEN SEEK CORRESPONDENCE for cultural exchange, language practice, friendship. Asian Exchange, Honokaa, Hawaii 96727

PENFRIENDS-ENGLAND-USA. Make lasting friendships through correspondence. Send age, interests. Free reply. Harmony, Box 89NH, Brooklyn, NY 11235

Camps

Boys 9-16

Farragut Naval Camps

Give your son a summer to remember! Boating & fishing trips. 50-boat fleet with 25 sailboats. All sports. 2 gyms, 3 athletic fields. Outdoor pool. Approved summer school. Opens July 5. Catalog. Also winter school at Farragut Academies in NJ and Florida. Grades 5-12. Farragut Naval Camps. Box ZC, Toms River, NJ 08753 • (201) 349-1121.

Education

DIG-A-ROCK GEOLOGY GAME. Learn while playing! Collect colorful rock, mineral, gem cards. Information booklet, more. $19.95. Kingworthy Educational Games, 115 Emerson Drive, Great Neck, NY 11023

EXPLORE MICROSCOPIC WORLD—algae, protozoans, blood cells, etc. New Science Course for all ages. How to purchase and use a microscope with free brochure. Life Sciences, Box 591P, Woodbury, NY 08096

FIELD COURSES IN NATURAL HISTORY. College Credit. Write Aspen Center for Environmental Studies, Box 8777A, Aspen, CO 81612

FREE—PARENTS GUIDE. Over 400 pvt. bdg. schools, camps & summer programs in U.S. & abroad, serving children 6-16. Most visited by publisher. For guide & free referrals give child's age, grade, interests, geo. preference & entrance date. Est. 1940. Vincent/Curtis, Rm. 216, 224 Clarendon St., Boston, MA 02116

MAINE ISLAND ECOLOGY. Marine biology, botany and ornithology on 200 acre island. Exciting opportunity for high school students interested in environmental studies. Faculty-student ratio 1:5. Over 10 years of operation. From June 26 to July 14 or July 18 to August 5. Contact Maine Island Ecology, Academy of Natural Sciences, Nineteenth and the Parkway, Philadelphia, PA 19103

FARRAGUT NAVAL ACADEMIES

A complete academic program: Oceanography, Naval Science, extracurricular activities, sports. Grades 5-12. Separate lower school. Small classes. Honor Naval School. Fully Accredited. Band. Riflery. Sailing. NJROTC. College guidance program. 2 waterfront locations. Write for catalog. *Admits students of any race, color, national or ethnic origin.*

NORTH: Box Z, Toms River, NJ 08753—201 • 349-1121
SOUTH: Box Z, St. Petersburg, FL 33710—813 • 384-5500

Employment Opportunities

AUSTRALIA NEEDS YOU! Jobs! Paid Transportation! Newest handbook, $2.00 (guaranteed). Australian International Services, Box 19107-RP, Washington, DC 20036

AUSTRALIA—NEW ZEALAND NEED YOU! Big Pay! 50,000 jobs. Free transportation. Latest listings $2.00. Austco, Box 772, Cypress, CA 90630

AUSTRALIA . . . NEW ZEALAND WANT YOU! 17,500 Jobs! Paid Transportation! New Report! $2—Moneyback Guarantee! "Australia Commission," Department 894-C4, National Press Building, Washington, D.C. 20045

FREE DETAILS—OVERSEAS JOBS! All occupations! 68 countries. Paid fare. Computerized reports. Jobworld, Box 681, Cypress, CA 90630

JOBS OVERSEAS—Big money fast. $20,000 to $50,000 plus per year. Call (716) 842-6000 ext. 134A

JOBS OVERSEAS (Including Alaska Gas Pipeline). Free Details. Global Employment, Box 808-NH, National City, CA 92050

OPPORTUNITY that promotes Environmental Harmony, Nutrition, Consciousness for Everyone. Write: Enhance, Box 198, Estherville, Iowa 51334

OVERSEAS—ALL OCCUPATIONS! Worldwide Directory and complete information—$3.00. International Opportunities, Box 19107-RP, Washington, DC 20036

ROCKY MOUNTAIN EMPLOYMENT NEWSLETTER! Colorado, Idaho, Montana, Wyoming! Current openings—all occupations! Free details . . . Intermountain-4Y, 3506 Birch, Cheyenne, WY 82001

TEACHERS - ADMINISTRATORS: School, college job openings: USA, $5.95; Abroad, $5.95. Placement, sources USA, $4.95; Abroad, $4.95. EISF, Box 662, Newton, Massachusetts 02162

Foreign Newspapers

WORLDWIDE ENGLISH NEWSPAPERS. 65 countries including Egypt! Sampler. 5/$2.98. Free Brochure. Multinewspapers, Box DE-204, Dana Point, CA 92629

Gourmet Interests

CALAMARI RECIPES. Stuffed, "abalone" style, sautéd. Economical,easy. $3.00, SASE. Pete, 1547C Santa Clara Avenue, Alameda, CA 94501

IMPRESS YOUR FRIENDS. Please your family. Prepare and serve American and international menus. New Gourmet Newsletter tells how. Free details for SASE. Time Exposure, Box 767, Merced, CA 95340

OUR FAVORITE GRANOLA! Perfect trail snack. Half the cost of commercial products, twice as tasty. Easily prepared. $1.00. SASE. Box 10341, Springfield, MO 65808

TOFU RECIPES—nutritious de-fattening dishes using soy bean curd. $2.00, SASE, to Ohno, Springbrook Circle, Ithaca, NY 14850

TWO SPECIAL CREAM PIE RECIPES, DELICIOUS. $2 to P.O. Box 4355, Hayward, CA 94540

Government Surplus

"GOVERNMENT SURPLUS DIRECTORY." Buy 500,000 items (including Jeeps) . . . low as 2¢ on dollar! Most complete information available-$2.00. Surplus Disposal, Box 19107-RP, Washington, DC 20036

SURPLUS JEEPS—$19.30!—CARS—$13.50!—650,000 Items!—Government Surplus—Most Comprehensive Directory Available Tells How, Where To Buy—Your Area—$2—Moneyback Guarantee—"Government Information Services," Dept. DC-4, Box 99249, San Francisco, CA 94109

Merchandise

FREE CATALOGUE. Distinctive merchandise for discriminating people. We have Wildlife Prints by the renowned James Lockhart, Austrian backscrubbers, Peoplefeeders, Norwegian Footwear Dryers, Admirals Lamps, things for the den, more. The Armchair Emporium Ltd., 825 Surrey Lane, Dept. NH3, Algonquin, IL 60102

INCA MOTIF 18KT. GOLD FILLED RING, fits all fingers. Send $13.50 to Lorenz, P.O. Box AL, Paterson, NJ 07509. Money back guaranteed.

"I LIKE IT WILD® . . . " Wilderness/wildlife posters, T-shirts, notecards. Send stamped envelope: Wilderness Dreams®, Box 4455-N, Shawnee Mission, KS 66204

NAME TAPES—protect clothing from loss at camp, school or anywhere. $4.00 per 100. Send names to Sterling, P.O. Box 110, Winsted, CT 06098

PURCHASE BOWIE, Civil War knives, Indian tomahawks. Robert Abels, 2881 N.E. 33 Court, Fort Lauderdale, FL 33306

Miscellaneous

GET CASH GRANTS—from Government. (Never repay.) Also, cash loans available. All ages eligible. Complete information, $2 (refundable). Surplus Funds-NH, 1629 K St., Washington, D.C. 20006

OLDTIME RADIO PROGRAMS on quality tapes. Free catalogue. Carl N. Froelich, Route One, New Freedom, PA 17349

70-110 YEAR OLD MAPS. All States. Stamp for Catalogue. Northern Map, Dept. HN, Dunnellon, FL 32630

WILD ANIMAL INFORMATION Questions answered. Send for free brochure. Harold Ferguson, RD#1, Box 129B, Natural Bridge, VA 24578

Music

RECORDS—TAPES! Discounts to 73%; all labels; no purchase obligations; newsletter, discount dividend certificates; 100% guarantees. Free details. Discount Music Club, 650 Main St., Dept. 25, 0481 New Rochelle, NY 10801

PLAY A MUSICAL INSTRUMENT? Specials on sheet music, collections, fake books, taped lessons much more. For catalogue send 50¢ postage and handling to: The Music Shopper, Dept. 105,. 223 Katonah Avenue, Katonah, NY 10536

Photography

COLOR AND B&W PHOTOGRAPHIC PRINTS made from your negative, print or slide. All are custom cropped and color corrected according to your directions. Call or write for price list. Great Big Pictures, Inc., 1444 E. Washington Avenue, Madison, WI 53703 (608) 257-7071

Optics

BINOCULAR SALES AND SERVICE. Repairing binoculars since 1923. Alignment performed on our U.S. Navy collimator. Free catalogue and our article "Know Your Binoculars," published in Audubon Magazine. Mirakel Optical Co., Inc., 331 Mansion St., West Coxsackie, NY 12192 (518) 731-2610

LEITZ, ZEISS, B&L, SWIFT, BUSHNELL, NIKON, Optolyth binoculars, telescopes and accessories. Send stamp for discount list. Specify literature desired. Large stock. Orders filled postpaid day received. Birding, Box 5N, Amsterdam, NY 12010

OPTIC DISCOUNTS: Binoculars—Telescopes—Brand Names—Free Catalogue. Thos. Manetta, 61 Hoffman Avenue, Elmont, NY 11003

Real Estate

FREE! Big Spring Catalogue! Over 5,400 country properties described, pictured! Land, Farms, Homes, Businesses, Recreation, Retirement buys! Selected best thruout the U.S. Over 700 offices, 43 states All Across America! Yours Free from the World's Largest! Strout Realty, Inc., 60 E. 42nd Street, Dept. 5390, New York, NY 10017

FREE . . . 296-PAGE CATALOGUE. Describes and pictures over 2,800 farms, ranches, acreages, businesses and town and country homes from coast to coast. United Farm Agency, Inc., 612-V W. 47th St., Kansas City, MO 64112. Ph. Toll-Free: 1-800-821-2599; MO. Res. Ph. Toll-Free: 1-800-892-5785

GOVERNMENT LANDS . . . FROM $7.50/ACRE! Homesites, farming, vacationing, investment opportunities! "Government Land Buyer's Guide" plus nationwide listings—$2.00. Surplus Lands, Box 19107-RP, Washington, DC 20036

SURPLUS LAND FROM $3.50/ACRE!—New Buyer's Guide shows how!—Vacation!—Investment!—$2 Moneyback guarantee! "Surplus Lands Bureau" 894-E4 National Press Building, Washington, DC 20045

Rentals

ADIRONDACK LODGES on Upper Saranac Lake. Available for two weeks or a month, July through September. Everything provided for comfortable living in the quiet woods. From $650–$1,700 for two weeks. Please write Bartlett Carry Club, RFD 3, Tupper Lake, NY

BED AND BREAKFAST at Wellfleet, Cape Cod, 02667 for a single or couple. Tel: (617) 349-3989

OLD FASHIONED, SECLUDED FARM on Cape Breton Island offers log cabins, excellent meals, peace to a few guests $225/week. Write: J. Gardner, Orangedale, Nova Scotia

PUERTO RICO: Charming, one-bedroom apartment on beach. Pool, tennis. Weather ideal. Weekly $400, monthly $1,000 (201) 343-3386

Resorts

MAINE: remote lodge, superb fly-fishing, hiking-Gulf Hagas, moose watching, berrying. Excellent food, maximum 10 guests. Little Lyford, Brownville, ME 04414

TOBAGO, PRIVATE BEACH COTTAGES on working cocoa plantation. Swimming, snorkeling, fishing from your front door. Bird watcher's paradise. Brochure. Charles A. Turpin, Charlotteville, Tobago, West Indies

VACATION/RELAXATION—Birdwatcher's delight—Peaceful, secluded nature lover's mountain retreat. Cave Creek Ranch, Portal, Arizona 85632

LITTLE ST. SIMONS ISLAND

One of Georgia's "Golden Isles"



Birding, beachcombing, riding, wildlife photography, fishing or just relaxing on a secluded 12,000 acre island with miles of unspoiled ocean beaches, forests and marshes. Over 200 species of birds. Maximum of 10-15 guests at a time. Excellent food and accommodations. Professional naturalists on the staff. **Little St. Simons Island** P.O. Box 1096N, St. Simons Island, GA 31522

Tours/Trips

ADVENTURES IN AFRICA and elsewhere. Gorilla safari in Rwanda and Zaire. Camping in Tanzania's Serengeti. Ecology study in Parks and remote areas of Kenya. Over 25 wildlife trips including Galapagos Islands, India, Nepal, Mexico, Hawaii and Alaska. Birding trips, polar bears, blue whales, asian rhino, tiger, and mountain gorilla. Small groups with expert leaders. Adventures International, 4421-N Albert St., Oakland, CA 94619

ALASKA TRAVEL ADVENTURES—Experience Alaska in guided intimate group trips. Backpacking, canoeing, kayaking, whitewater, wildlife photography, fishing, custom trips. Alaska-Hawaii Combinations. Free catalogue describes 50 different trips throughout Alaska for all ages and abilities. Contact Alaska Travel Adventures, 499 Hamilton, Suite 212-PP, Palo Alto, CA 94301. In California call collect (415) 329-9013, elsewhere toll free (800) 227-8480

ALASKAN WATER ADVENTURES. Kayaking, Rafting, Birding in Prince William Sound and Copper River Basin. Open Door, Box 1185N, Cordova, Alaska 99574 (907) 424-7466

ALPS OF SWITZERLAND, MODERATE DAY HIKING—Two or four week tours. Brochure. Alpine Adventure Trails Tours. 783P Cliffside Drive, Akron, OH 44313

ANDES TREKKING: Cordillera Blanca and Inca Trail, Peru. Amazon wildlife extension. Three weeks, July. $995.00. McGregor Adventures, 33-N Lewis Street, Greenwich, CT 06830. Toll Free (800) 243-5330

ARCHEOLOGICAL FIELD SCHOOL—8 week field school in archeological excavation on Wester Anasazi site in southwest Utah. June 15 to August 8. No previous experience required. 15 quarter credits. Non-credit participation by adult avocational archeologists open for 2 to 8 week periods. Total enrollment limited to 20. For cost information write to Dr. Richard A. Thompson, Southern Utah State College, Cedar City, Utah 84720

CANOE TRIPS IN WILDERNESS NOVA SCOTIA, July-September. Small groups with licensed guides. Excellent food. Write: Granville Nickerson, RR#4N, Annapolis Royal, Nova Scotia, Canada BOS 1AO

CANOE WILD MAINE—Learn woods skills and natural history while canoeing northern Maine. Individuals, families, and conservation organizations welcome. Special courses with colleges. North Woods Ways, Box 34, Salisbury Cove, ME 04672

BIRDS WORLD RECORD: "Explorer's Inn", Amazonas, Peru. Abundant other Fauna/Flora. Visit it! 2437 Durant, Berkeley, CA 94704 (415) 843-8294

GALAPAGOS AND INCA PERU. The trip of a lifetime. A small group tour offering individual attention. Two departures for two weeks each. August 12, 1981 and February 1982. C st $2,698 U.S. per person. Limited space available. For further information contact Wings of the World, Inc. Travel, 653 Mt. Pleasant Road, Toronto, Canada (416) 482-1223

GALAPAGOS/ECUADOR/PERU. Economic guided tours from $1459. 8 to 15 days Galapagos, all meals. Weekly departures. Options: Quito, Amazon, Cuzco/Machu Picchu. University credit available. Details: J.A. Colley, LAST, Inc., 43 Milestone Road, Randallstown, MD 21133 (301) 922-3116

GALAPAGOS/ECUADOR/PERU natural history wildlife trekking and jungle expeditions to remote areas of Peru, Ecuador, Costa Rica, Brazil, Patagonia and Galapagos. Expert expedition leaders. Write: Wilderness Travel (formerly South America Wilderness Adventures), 1760-NB Solano Avenue, Berkeley, CA 94707 (415) 524-5111

GALAPAGOS HIKING AND SAILING EXPEDITIONS. Machu Picchu option. Also exhilarating horseback expedition to Peru and Machu Picchu. Inca Floats, 5982N Balboa, Oakland, CA 94611 (415) 339-9095

HIMALAYAN ADVENTURE TREKS—Rammel Expeditions, Box 183, Tetonia, Idaho 83452. Enthusiastic Rammel trekkers will describe our quality trips on request. Write for reference list and information.

HIMALAYAN TRAVEL, INC. Trekking expeditions in the Everest and Annapurna areas of Nepal. Exotic cultures/spectacular mountain scenery. Box 481-NH, Greenwich, CT 06830 Toll Free (800) 243-5330

HIKE THE SWISS ALPS. Swissair flies you to special hiking tours, led by popular author/mountaineer Fred Jacobson. Zermatt, Saas-Fee, Lenk, Kandersteg, Pontresina. Beautiful and challenging trails. Delightful country inns. Superb cuisine. 9th summer! Write Fred Jacobson, Dept. NH4, Chappaqua Travel, 24 S. Greeley Avenue, Chappaqua, NY 10514

INTERNATIONAL NATURE & TREKKING TOURS. Galapagos, Peru, Nepal, Ecuador, Alaska, Tanzania, Kenya, Patagonia, Falkland Islands, Costa Rica, Guatemala and more. Expert leaders. Very small groups. Write: Wilderness Travel (formerly South American Wilderness Adventures), 1760-NH Solano Avenue, Berkeley, CA 94707

LEGENDARY CULTURES, FASCINATING NATURE: Peru (Ecuador, Galapagos, Amazonas). Mayaland. Africa. Custom trips, Expert leadership. Forum Travel, 2437 Durant, Berkeley, CA 94704 (415) 843-8294

LLAMA PACK TRIPS: Colorado mountain wilderness hiking tours with llamas to carry your gear. Rocky Mountain Llamas, 5893 Baseline Road, Boulder, CO 80303

NATURALIST GUIDED FIELD SEMINARS and tours, West Texas and Mexico. Rafting, hiking, backpacking, bus. University or Continuing Education credit as appropriate. Write Education Department, Chihuahuan Desert Research Institute, Box 1334, Alpine, TX 79830

NATURE PHOTOGRAPHY field work and instruction in remote, mountain locations throughout the West. Brochure: The Natural Image, P.O. Box 45, Winthrop, WA 98862

NORTH SCOTLAND: HIGHLAND WILDERNESS. Explore, study, interpret the wildlife, vegetation, terrains & impact of man on a surpassingly beautiful land. Small group led by local Scot who knows surfaces & depths of his home place. 7-14 day programs, Apr. thru Oct. Details: Albannach Ltd., Hamilton House, Ross & Cromarty, Strathpeffer, Scotland

OAXACA, MEXICO. Unique historical/cultural tour. Festivals; pre-Hispanic art, Mixtec, Zapotec civilizations. Oaxaca Club (415) 388-3503

ORIENTAL ECLIPSE EXPRESS. China—Mongolia—Siberia. Hong Kong, Nanking, Sian, Peking, Ulan Bator, Lake Baikal, Irkutsk, and Bratsk. View 31 July 1981 Solar Eclipse. 21 days-$3595. Baylis-Todd Eclipse Tour, Claremont Hotel, Berkeley, CA 94705 (415) 849-4333

PERU: Andean Archaeological trek along Inca Trail to Machu Picchu. August - Two weeks. Small group. Budget - $985. Write: High Country Passage, Box 1100-NH, Hamilton, Montana 59840 (406) 363-2555

SAVE ON LUXURY CRUISES! (Passenger ship or Freighter) How? Ask TravLtips, 163-09 Depot Road, B514, Flushing, NY 11358

SCOTLAND, ORKNEY, SHETLAND AND ICELAND. Comprehensive program of nature trips. Write: Caledonian Wildlife at McGregor Travel, 33 Lewis Street, Greenwich, CT 06830, or toll-free: (800) 243-5330

SINGLE TRAVELERS: natural history of the Southwest 5/2/81. Georgia Island Birding & Beachcombing 8/22/81. Maine Windjammer 8/23/81. All Travelers: Hike-Camp Hawaii 9/26/81. Southwest Photo Workshop 6/21/81. New England Whale Research Expedition 9/18/81. Mt. McKinley Base Trek 8/7/81. Blue Sky Adventures, Dept. NH4, Oak Ridge, NJ 07438

STONE RINGS IN ENGLAND AND SCOTLAND: Visit over twenty (of the 900!) rings of standing stone in the British Isles, including Stonehenge and Avebury. Time also for castles, churches, cathedrals, and Roman antiquities. Coach tour, July 1-17, 1981. Lyman C. Peck, (Miami University) 223 Field Crest, Oxford, Ohio 45056 (513) 523-2480

TRAVEL PHOTOGRAPHY WORKSHOP IN SANTA FE with Lisl Dennis, author of "How to Take Better Travel Photos," HP Books. Aug. 29-Sept. 5 and Sept. 5-12. P.O. Box 2847, Dept. X, Santa Fe, NM 87501

WILDERNESS TRAILS IDAHO. Backpacking, Ski-touring, and Bicycle-touring. Come adventure and learn with us. Trips for all abilities, everything provided. We have thirteen years experience and guide only in Idaho. Write: P.O. 9252 M, Moscow, Idaho 83843 (208) 882-1955

RATES AND STYLE INFORMATION

$1.75 per word; 16 word ($28) minimum. *Display classified* is $150 per inch. All advertisements must be prepaid. Rates are not structured for agency or frequency discounts. All advertisements are accepted at NATURAL HISTORY's discretion. Send check/money order payable to NATURAL HISTORY to: The Market, NATURAL HISTORY Magazine, Central Park West at 79th St., New York, NY 10024. Please include your personal address and telephone number, issue preferred, and suggested heading. Deadline—8th of month, two months prior to cover date (the January issue closes Nov. 8). Camera-ready art is required for display ads. A tearsheet or copy of the page with your ad will be sent upon publication.

Box numbers, telephone numbers, and hyphenated words count as two words; abbreviations and zip codes as one word each. All states are shown in two-letter code followed by zip, then telephone (with area code), if desired. Occasionally, slight editing is required for clarity. Thank you!

Celestial Events

by Thomas D. Nicholson

The Moon Except possibly for a brief glimpse of the slim, late crescent during dawn on the first of the month, don't expect to see the moon until a few nights after the April 4 new moon. The earliest view of the thin, waning crescent should come on the evening of the 7th, with the moon in Taurus, between the bright, reddish star Aldebaran and the closely packed group of stars known as the Seven Sisters (or the Pleiades). First-quarter moon on April 11 will be near Castor and Pollux (in Gemini) and full moon on April 19 will be near Spica (in Virgo). Thereafter, the moon is in the morning sky. Last-quarter moon is on April 27, new moon in May on the 5th, and first-quarter on the 10th.

Stars and Planets Evening planets have been scarce so far this year (for half of February and most of March there was only Mars, which barely made it), but this month they come back in a stampede. Three planets make the transition into the evening sky in April (Mercury, Venus, and Pluto) and one more in May (Uranus). So, even though Mars is going the other way (into the morning sky), six of the planets will be evening stars (above the horizon at sunset) at some time during April.

Despite all the shifting around in the morning and evening sky, however, only two planets, Jupiter and Saturn, are easily visible in April and early May. In the morning they are in the west, setting during morning twilight. To find them, just look for the brightest starlike object in the sky. That will be Jupiter. The "star" near it is Saturn. The next nearest bright star (about as bright as Saturn) is Spica. Jupiter and Saturn remain close to each other throughout April and May, although the brighter Jupiter separates slowly to the right (west) of Saturn. Both planets are moving retrograde (westward) relative to the stars around them, Jupiter more rapidly than Saturn. You can readily observe their movement by comparing their positions, night by night, with Spica, to their left (east).

The sun is in the constellation Pisces until late in April and then moves into Aries. Mercury spends time in Aquarius in early April, in Pisces after midmonth, and in Aries before the end of April. Venus and Mars are in Pisces at the beginning of April and move into Aries after midmonth. Jupiter and Saturn are in Virgo, Uranus is in Libra, Neptune in Ophiuchus, and Pluto is along the border between Virgo and Bootes.

April 2: Mars is in conjunction with the sun, leaving the evening sky as it shifts to the sun's morning (right) side.

April 5: Perigee moon (nearest the earth) occurs today, about twenty-four hours after new moon. The effect of perigee will enhance the normally strong spring tides that accompany the new moon.

April 7: Venus is in superior conjunction (in line with and beyond the sun), passing the sun from right to left. This takes it into the evening sky, where it will be seen in the late twilight toward the end of June.

April 16–17: Tonight will bring an exceptional opportunity to watch the moon slide past Jupiter and Venus. After sundown, the three objects are above the eastern horizon, the gibbous

moon so bright that only the two bright planets can be seen near it. Jupiter (the brighter) will be to the moon's right, Saturn below. In a short time, the moon's motion will be apparent, and the arrangement changes through the night as the objects move across the sky. The moon passes closest to Jupiter at about 8:00 P.M., EST, closest to Saturn about 1:00 A.M., EST (on the 17th). The bright star east of them is Spica.

April 17–18: The moon (one day closer to full) is near Spica, with Jupiter and Saturn to their west (right).

April 20: The moon is at apogee (farthest from the earth).

April 21–22: The Lyrid meteor shower, reliable but not particularly productive (about 15 meteors per hour), is at maximum. Look for meteors after 1:00 A.M.

April 27: Mercury, at superior conjunction, moves to the sun's left and becomes an evening star.

May 3–4: The perigee moon, coming within an hour of new moon, will enhance spring tides tonight and tomorrow. The effect of perigee will be much stronger than in early April, since it comes so close to new moon. The Eta Aquarid meteor shower (about 20 per hour, but often bright) is at maximum on the morning of the 4th.

May 10–11: The first-quarter moon tonight is near Regulus, the brightest star in Leo, moving closer to it during the night. The moon passes above Regulus during the day on the 11th, and will be seen moving away from the star during that evening.

May 13–14: The gibbous moon is near Jupiter early tonight, passing above it at about 10:00 P.M., EST, then passing above Saturn.

Oriental Shou motif, deeply etched on a set of 6 double old fashioned glasses #111 $22 Members $19.80 Matching 2 qt. Pitcher #112 $25 Members $22.50



Long Life!

American Museum of Natural History
Museum Shop Dept. 228
P.O. Box 174
Scarsdale, N.Y. 10583

Please print
Name
Address
City State Zip

Item #	Qty.	Description	Price	Shipping/ handling	Total
111		Glass set of six		3.00 per set	
112		Pitcher		2.50 each	

Customer Inquiries: Call 212 799-8958

Most deliveries will be made by U.P.S. so please provide street address.

Order Total
N.Y. State Tax
Total Amount

Member Membership # Non Member
I've enclosed check or M.O. in the amount of $ payable to American Museum of Natural History (NO C.O.D'S)
Charge To: Master Charge Visa American Express
Account # Exp. Date
Signature (req. if using credit card)

The Amazing Stirling Cycle **Hot Air Engine**

Heat is the only fuel required!

7¼" x 4"



Silent
Safe
Fully Tested

ALL METAL
SPEEDS TO 1000 RPM
BUILT-IN ALCOHOL BURNER

A marvelous opportunity to acquire an early model Stirling Cycle Engine and acquaint yourself with little known facts about a product of the past that may well hold promise for the future.

The average person has never heard of the Stirling engine, so the sight of one quietly running with heat as its only fuel will at first amaze them and then excite their imagination. This is the first in a family of six different desk-top model hot air engines to be issued during the next three years.

Experimenters • Hobbyists' Power Source
Students • Collectors • Model Engineers

An easily read, lavishly illustrated, 128-page book accompanies each engine or may be purchased separately. This publication, the first of its kind, takes the reader on a 160-year tour through the world of Stirling Cycle Engines. Illustrations include the Stirling, Roper, Heinrici and the amazing new Stirling-powered Ford Torino!

Solar Engines • 4020 East McDowell Road, Phoenix, AZ 85008 U.S.A. (602) 273-6191

Please send me: _____ Engine and Book @ $38.50 . . . $_____
_____ Book (separately) @ $ 5.50 . . . $_____
(Domestic shipments sent postpaid. International (airmail) please add: $11.00 for Engine; $2.00 for Book only.) TOTAL $_____

Enclosed
☐ Check ☐ Money Order
Charge My
☐ American Express ☐ VISA
☐ Diners ☐ Master Charge

INTERBANK NO.
CARD NO.
EXPIRATION DATE

SIGNATURE
NAME (PLEASE PRINT)
ADDRESS
CITY STATE ZIP NH-2

CREDIT CARD BUYERS DIAL: (800) 528-6048

Elephants (p. 30)

A good general source on the natural history, ecology, and behavior of elephants is I. and O. Douglas-Hamilton's popular account of their field research in Tanzania, *Among the Elephants* (New York: Viking Press, 1975). A recent article by O. Douglas-Hamilton, "Africa's Elephants: Can They Survive?" (*National Geographic*, November 1980, pp. 568-603) focuses on how ivory poachers, destruction of elephant habitat, and political upheaval throughout Africa are threatening the elephant's survival, and includes a census of Africa's elephant population by I. Douglas-Hamilton. Publications dealing specifically with the Tana region, however, are rare. In "Water Availability and Its Influence on the Structure and Dynamics of a Savannah Large Mammal Community" (*East African Wildlife Journal*, December 1975, pp. 265-86), D. Western describes an environment similar to that of the Tana, the Amboseli region of Kenya, where highly seasonal water availability has an important effect on the structure and efficiency of the large mammal community. *Rangeland Management and Ecology in East Africa*, edited by D.J. Pratt and M.D. Gwynne (London: Hodder and Stoughton, 1977), describes the ecology of grasslands and bushlands such as those in the interior of the Tana region. S. Holman gives an account of a campaign waged against traditional elephant hunters in the Tsavo Park region, adjacent to the Tana, in *Massacre of the Elephants* (New York: Holt, Rinehart and Winston, 1967). G. Caughley gives a critique of different hypotheses on elephant management in Africa in "The Elephant Problem—An Alternative Hypothesis" (*East African Wildlife Journal*, December 1976, pp. 265-83).

Street Urchins (p. 40)

Originally published in 1890, J.A. Riis's forceful indictment of New York City's slum tenements, *How the Other Half Lives* (New York: Hill and Wang, 1957), contains a section on "street Arabs." Riis's highly personal and reminiscent narrative is, unfortunately, occasionally marred by a paternalistic, ethnocentric tone. Meant as a workbook for children in religious secondary schools, B. Peachment's *The Defiant Ones* (Oxford: The Religious Education Press Ltd., 1969) presents, through drama, the biography of Father Borelli and other twentieth-century social workers. Australian novelist M. West's *Children of the Sun* (London: Heinemann, 1957) is a sympathetic, illustrated dramatization of the plight of Naples' street urchins—the *scugnizzi*—and the story of Father Borelli's efforts to aid them. *A Street Lamp and the Stars* (New York: Coward McCann, 1963) by M. Borelli and A. Thorne, is Father Borelli's autobiography. The screenplay of Luis Buñuel's *Los Olvidados* is translated by N. Fry in *The Exterminating Angel, Nazarin, and Los Olividados* (New York: Simon and Schuster, 1972).



Tana River elephant James Allaway

Meteorites (p. 52)

Among the most useful books on meteorites are such standards as B. Mason's *Meteorites* (New York: John Wiley and Sons, 1962); E.L. Krinov's *Principles of Meteoritics* (New York: Pergamon Press, 1960); F. Heide's *Meteorites* (Chicago: University of Chicago Press, 1957); and J.A. Wood's *Meteorites and the Origin of Planets* (New York: McGraw-Hill Book Co., 1968). A comprehensive introduction to space science, *Space Geology*, by E.A. King (New York: John Wiley and Sons, 1976), includes chapters on meteors, tektites, craters, terrestrial impact craters, and asteroids, and also contains a glossary. G.J. McCall's basic exposition *Meteorites and Their Origins* (New York: John Wiley and Sons, 1973) offers a large, useful bibliography. Designed as a reference work on solar system studies, *The Moon, Meteorites, and Comets*, vol. IV of *The Solar System*, edited by B.M. Middlehurst and G.P. Kuiper (Chicago: University of Chicago Press, 1963), provides a section on meteor-

ites, their chemical composition and ages, meteoritic impacts on Earth, and the crater-forming process. *Out of the Sky* (New York: Dover Publications, 1959) and *Our Stone-pelted Planet* (Boston: Houghton Mifflin, 1933) are nontechnical introductions to meteoritics by H.H. Nininger. *Yamato Meteorites Collected in Antarctica in 1969*, edited by T. Nagata (Tokyo: National Institute of Polar Research, 1975) is a technical report of the general properties of the meteorites found in Antarctica's Yamato Mountains. "Antarctica: A Deep-Freeze Storehouse for Meteorites," by W.A. Cassidy, E. Olsen, and K. Yanai (*Science*, November 18, 1977, pp. 727–31), explores how the arctic environment preserves meteorites for long periods of time under very clean conditions. W.K. Hartmann's "Cratering the Solar System" (*Scientific American*, January 1977, pp. 84–99) analyzes craters on different celestial bodies, including Earth, and stresses the importance of cratering as a key to the solar system's history. In "Apollo Objects" (*Scientific American*, March 1979, pp. 54–65), G.W. Wetherill discusses this class of asteroidlike bodies, whose orbits cross the earth's orbit and which may be comet nuclei that have lost their volatile components. An article by Wetherill, "The Allende Meteorite," appeared in *Natural History*, November 1978, pp. 102–107. L. Grossman's "The Most Primitive Objects in the Solar System" (*Scientific American*, February 1978, pp. 30–38) is an essay on carbonaceous chondrites, mixtures of minerals that condensed out of the solar nebula. In "Did a Supernova Trigger the Formation of the Solar System?" (*Scientific American*, April 1978, pp. 124–39), D.N. Schramm and R.N. Clayton propose that measured isotope ratios can be combined with other evidence to construct a tentative account of events that gave rise to the solar system.

Rita Campon



If you'd like to know more about this unusual old store, drop us a line

AT THE LYNCHBURG HARDWARE & GENERAL STORE, you'll find everything from darning thread to duck decoys.

And, just a short walk away, you'll find Jack Daniel's Distillery, where we still make whiskey the same way we did 114 years ago: gentling every drop with a process called charcoal mellowing. If you live in a big city, you won't find a store much like Lynchburg's. No matter where you live, you won't find a distillery much like Jack Daniel's.



CHARCOAL MELLOWED DROP BY DROP

Tennessee Whiskey • 90 Proof • Distilled and Bottled by Jack Daniel Distillery
Lem Motlow, Prop., Inc., Route 1, Lynchburg (Pop. 361), Tennessee 37352
Placed in the National Register of Historic Places by the United States Government.

Lucy in the Sand with Footnotes

by Matt Cartmill

LUCY: THE BEGINNINGS OF HUMANKIND, by Donald C. Johanson and Maitland A. Edey. *Simon and Schuster, $16.95; 409 pp., illus.*

She lived unknown, and few could
know
When Lucy ceased to be;
But she is in her grave, and oh,
The difference to me!
William Wordsworth

When Don Johanson christened his 3.5-million-year-old Ethiopian woman-ape, what he had in mind was John Lennon's *Lucy in the Sky with Diamonds*, not Wordsworth's sweetheart. But the Wordsworth version fits better: dead woman, dates uncertain, nameless grave. And oh, the difference to Johanson—and to anthropology in general. Since that November afternoon in 1974 when he and Tom Gray hugged each other and danced a jig among Lucy's half-buried remains in a gully near the Awash River, Johanson has been transformed from a brash young Ph.D. with a nervous grin and a promising Pliocene site into a paleoanthropological superstar with a trunkful of the most dazzling fossil-hominid jewels ever to come out of the East African hominid mines.

The late Louis Leakey spent half a lifetime prowling and sweating up and down Tanzanian arroyos to amass a similar collection of fossils. It took Johanson and his team just two field seasons to come up with Lucy—a hominid skeleton that is more than *3 million years older* than the next-oldest reasonably complete skeleton of a human ancestor. The following year, Johanson's group found the remains of thirteen or more individuals in a clump, all apparently killed at once by a flash flood—a sort of quick-frozen primeval horde that gives us the only evidence we have about the variability and composition of early hominid bands. The year after that, the group found the earliest-known stone tools. Any one of these finds would be enough to catapult the finder into international prominence and turn competitors green with envy. Johanson's competitors and colleagues, myself included, have been Day-Glo chartreuse for the past five years.

In the late 1960s, when Johanson was a graduate student, there were three broad schools of thought about human evolution. Each school had a different idea about the number of hominid species that had coexisted in the African Pleistocene, and so they were sometimes called the one-, two-, and three-species schools. Their real disagreements, however, were about what it means to be human. The two-species interpretation, which Johanson absorbed from his teachers at the University of Chicago, had its roots in the thinking of Raymond Dart and his view of man as Killer Ape. According to this school, early hominids were of two sorts, corresponding roughly to Lennie and George in John Steinbeck's *Of Mice and Men*. There was *Paranthropus*, a big, dumb vegetarian type, and *Australopithecus*, a small, wiry meat eater who subsisted by bashing the local fauna with slightly sharpened rocks. As time went on, according to the two-species scenario, the nasty little killer got smarter and handier with rocks, exterminated the big herbivore, and went on to evolve into Man the Hunter.

The one-species believers were egalitarians with vaguely leftish antecedents (notably Leslie White and G. F. Gause), who traced hominid origins to tool using and believed that it was impossible for more than one such tool-using, culture-bearing species to exist at a single time. In their view, *Paranthropus* was neither retarded nor herbivorous, but just an intermediate population on the lineage leading from *Australopithecus* to *Homo*—and all three probably ought to be called *Homo*. Some fans of Marx who clung to the fringes of this school weren't above hinting that the two-species people were closet apologists for apartheid. Finally, the three-species school saw the brain as the hallmark of humankind and held that most known fossils, with their jutting brows and receding foreheads, could not possibly be ancestral to university professors.

The three-species school got its nickname from the ideas of its leading exponent in the 1960s, Louis Leakey, who devoted his career to searching for advanced *Homo* in the early Pleistocene of Africa. At Olduvai Gorge, he believed he had found, in addition to a *Paranthropus* and a beetle-browed *Homo erectus*, a gracile hominid with a small brow ridge and a respectably large brain. Leakey and his coworkers christened this third species *Homo habilis*, and Leakey acclaimed it as the true ancestor of *Homo sapiens*. Almost every anthropologist pooh-poohed this notion. The two-species people insisted that early *habilis* was just *Australopithecus* and later *habilis* was just *H. erectus*. The single-species enthusiasts, perplexed at first by finding supposed ancestors and descendants living side by side, finally decided that the little *Paran-*

thropus types were females and the big ones were males.

This last-ditch effort to save the single-species theory foundered in the early 1970s when Louis Leakey's son Richard began uncovering dozens of beautiful early hominid fossils from the Koobi Fora area in Kenya. These finds included great flat-headed *Paranthropus* forms like the ones from Olduvai, all chewing muscles and no forehead, as well as unmistakable *Homo* with a delicate brow ridge and a relatively roomy, high-vaulted braincase. Richard Leakey's prize *Homo* specimen, number 1470, was an astonishingly modern-looking skull dated by the potassium-argon method to almost three million years ago—about a million years older than the oldest fossils at Olduvai. The single-species theory kicked feebly and expired. With 1470 in the picture, all the competing theories seemed too simple-minded. It began to look as if the hominid family tree had resembled a dense bush, with many little local species pursuing their own specialized evolutionary careers. A theoretical vacuum appeared at the heart of human evolutionary studies and grew throughout the 1970s.

At first, Johanson's finds in the Awash River valley spawned even more confusion. His site of Hadar seemed to be about the same age as Koobi Fora; the earliest datable deposits at Koobi Fora were some 2.6 million years old, those at Hadar only about 400,000 years older. The two sites were no more than 500 miles apart. But Hadar's hominids looked nothing like Koobi Fora's. They included little things like Lucy—a dwarfish, half-simian biped about

Old World Charm



Quebec City Québec

Cobbled streets. Café au lait at quaint little restaurants. Houses with gingerbread roofs and balconies. Chanteuses who'll sing to you from the heart. Come on up.

Canada

SO MUCH TO GO FOR

This course (*specifically designed by the U.S. Department of State for Diplomats with little or absolutely no knowledge of the language to be studied*) is **complete, unedited** and includes the official Foreign Service Institute book with text for basic and advanced instruction. It begins in English and will gradually build your skills until you can comfortably handle the entire lesson in your new language. In a matter of weeks, you could be speaking your new language like a member of the U.S. Foreign Service Corps.

ONE LOW PRICE FOR YOU...ALL OTHERS LEARN FREE!

What an incredible value! For the single purchase price of one course your whole family can learn a new language and keep the course for years of fun and future reference.

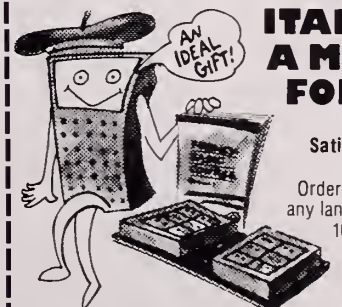
The *complete* full length Foreign Service Language Course is now being offered in two volumes:

VOL. 1, BASIC SPANISH 15 cassettes (19 hours) and 464 pg. Foreign Service Institute text **$99.95**

VOL. 2, ADVANCED SPANISH 21 cassettes (27 hours) and 464 pg. Foreign Service Institute text **$89.95** (The number of cassettes in FRENCH, GERMAN and ITALIAN Courses vary slightly from the SPANISH Course.)

FREE TRIAL OFFER. Try this course for three weeks. If you aren't convinced it's the fastest, easiest, most economical way to learn a new language, return the course for a full refund with no questions asked. Order yours right now!

For immediate delivery, fill in the information on the bottom of this ad and mail it with your check, Money Order or charge to your AmEx, Visa or Master Card by enclosing card number, expiration date and signature.



LEARN SPANISH, FRENCH, ITALIAN OR GERMAN LIKE A MEMBER OF THE U.S. FOREIGN SERVICE CORPS.

(each course is less than $100!)

Satisfaction guaranteed or your money back. AN IDEAL GIFT!

SPECIAL INTRODUCTORY OFFER!

Order both BASIC and ADVANCED Course in any language and take advantage of a full 10% discount! **Mail to: AMPRO PRODUCTIONS** 150 Fifth Avenue, New York, NY 10011.

NOW you can order by phone 24 hours a day! Call collect (9AM - 6PM EST) **(212) 243-7726**

N.J., N.Y., CT., residents can also buy direct at our Fifth Avenue office (at 20th Street)

Fill in the line below with the language you wish to learn...then check basic, advanced or both.

(Language)

☐ Basic $99.95 ☐ Advanced $89.95 ☐ Both 10% OFF TOTAL NH3

Sri Lanka's
PERAHERA
Festival of the August Moon

Join a special tour to Asia's most spectacular celebration honoring the Sacred Tooth Relic of the Buddha. A hundred elephants, dancers, drummers, temple bells, the cracking of whips, blazing torches that light a myriad gems create the stunning pageantry of the Kandy Perahera.

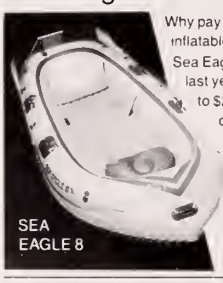
You also tour the countryside to see ancient cities in the interior, the hill country, coastal villages, spice gardens, tea estates and craft centers. Extensions to the mountain valley of Kashmir and to the temple cities of South India are available.

For information please contact:

JOURNEYWORLD INT'L LTD.
155 EAST 55th ST NEW YORK, N Y 10022
TEL (212) 752-8308

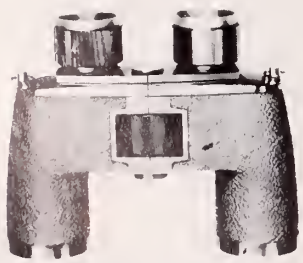
SEA EAGLE

The Quality Alternative
to High-Cost Inflatables



Why pay $600 or more for an inflatable boat?
Sea Eagles pack small, last years and cost $100 to $220. Canoes, dinghies and motormount boats. Write for **FREE** brochure.

Sea Eagle,
Dept. NH-4
St. James, NY 11780
phone 516-724-8900



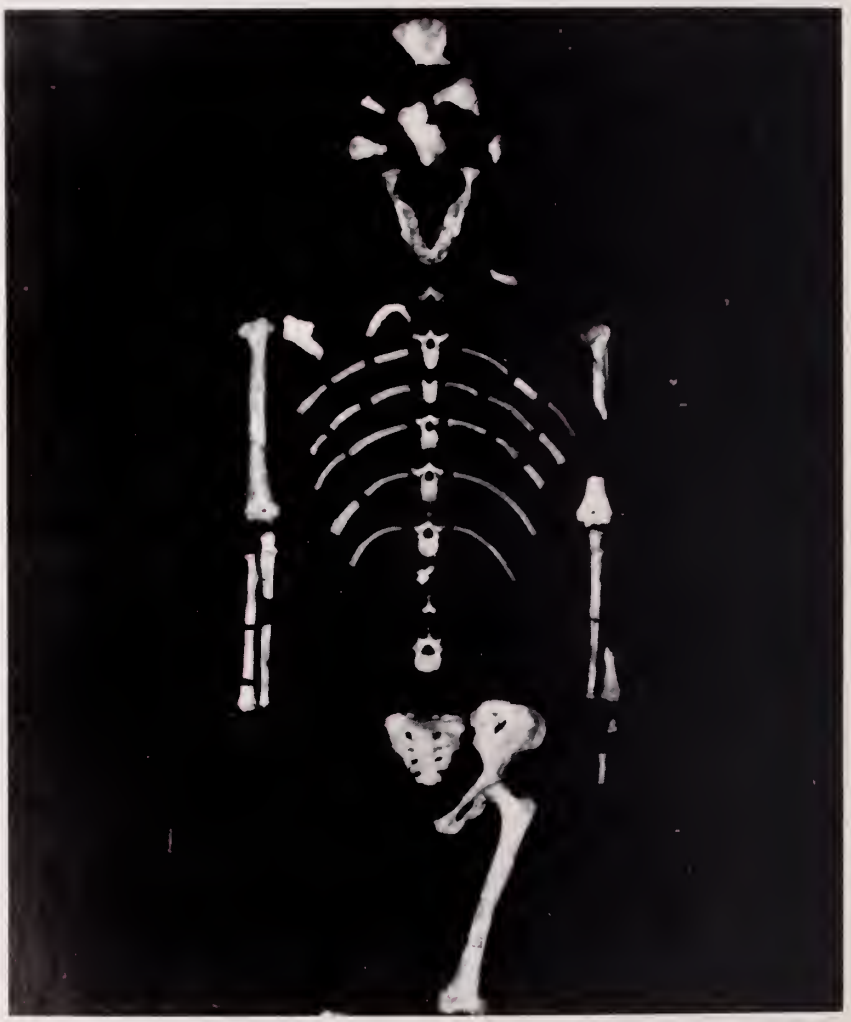
BUSHNELL 7x35 CUSTOM
Mfg. List $280.00 **Postpaid $164.00**
This is an example of the deep discount prices on high quality optics that is found in our FREE catalog. This catalog lists and illustrates an outstanding selection of telescopes, binoculars etc., plus valuable information on how to properly select them. Write for it today.

GIL HEBARD OPTICS
COURTHOUSE SQ., KNOXVILLE, ILL. 61448

three and a half feet tall, with a V-shaped lower jaw and a head the size of a softball—as well as larger creatures fully human in stature but with their molar teeth set in parallel rows like a chimpanzee's. Where was 1470 in this picture? Had he popped into existence in a mere 400,000 years by some sort of macromutation? Where did *Homo* come from, and why?

In the last three years, this series of puzzles has been partly solved, and a new picture of human evolution is beginning to emerge. The crucial step was realizing that 1470 was a million years younger than Richard Leakey had thought. The Koobi Fora site had a suspicious aroma from the beginning; not only was the 1470 skull a million years more advanced looking than other 3-million-year-old hominids, but it was surrounded by equally precocious horses, pigs, and elephants. The current consensus, based on new potassium-argon dates, is that the Koobi Fora deposits are only slightly older than the lowest levels at Olduvai and that there is no good evidence for *Homo* prior to about 2 million years ago. But there are now lots of hominid fossils from almost 4 million years ago: from the Hadar site (which the latest estimates date back to something over 3.7 million years), and from Mary Leakey's site of Laetoli. The great contribution of Johanson and his colleagues has been to sort out these earlier hominids and provide a sensible scheme for hooking them up with the later ones.

In 1976, Tim White, who had worked at Koobi Fora and had described the Laetoli hominids, began trying to convince Johanson that the Hadar and Laetoli hominids represented a single species. Two years of argument, calculation, and browbeating punctuated with sarcasm brought Johanson around, and in 1978 he and White assigned all the Hadar and Lae-



Lucy (Australopithecus afarensis) Cleveland Museum of Natural History

toli hominids to a new species: *Australopithecus afarensis*. Johanson and White regard this species as ancestral both to the later *Australopithecus* lineage (terminating with *Paranthropus*) and to the *Homo* lineage (from *habilis* to *erectus* to *sapiens*). This hypothesis makes concessions to all the old theories from the sixties. The one-species school was right in claiming that *Australopithecus* evolved into *Paranthropus*. They were also right in thinking that sexual dimorphism—the sum of differences between males and females—was greater in early hominids than it is in ourselves; Johanson and White now see the larger Hadar hominids with their U-shaped jaws and big front teeth as hulking male counterparts of the smaller females, such as Lucy. The three-species people were right in believing in an early separation of *Homo* and *Australopithecus* and in insisting that *habilis* was a separate species. The two-species people were the most nearly right of all; they erred only in trying to squeeze the later *Australopithecus* into the human ancestry.

The theoretical vacuum—the question of how we got where we are and what it means, which is what lends significance to all this gnawing of dead bones—remains to be filled. Big brains are out as a causal factor in early hominid evolution. Even tool making is starting to look less important, at least so far as *Australopithecus* is concerned. We know from the Hadar fossils (and from the astonishing discovery of a trail of hominid footprints in a volcanic ashfall at Laetoli) that these earliest undoubted hominids were, despite their ape-sized brains, upright bipeds like ourselves. They had short-fingered, human-looking hands that were suited well enough to making and using tools. But there is no evidence that they did so. Stone tools don't appear in the fossil record until just over two million years ago. Wherever stone tools are found, so is early *Homo* (with the minor exception of one late *Paranthropus* site from South Africa). If we accept the evolutionary tree offered by Johanson and White, the evidence suggests that the use of stone tools was a later invention that appeared in the *Homo* lineage at about the time the brain began to expand—which is probably not a coincidence. But the *Australopithecus* line of small-brained bipeds continued to survive alongside early *Homo* and his stone tools. *Australo-*

The Last Best West



Jasper Alberta

Big, beautiful, sprawling, unspoiled. New highs for trail riders and tamer turf for tenderfoots. Try some of the best beef in North America. Come on up.

Canada

SO MUCH TO GO FOR

All Records and tapes ... yours now at 30-45% off!

Whether you like classical, jazz opera, Broadway, folk, nostalgia, country, pop or children's music... the entire family can shop at one time and save big money! We offer all labels and all artists. You may even charge to VISA, American Express and Master Charge. No commitments and you may cancel at any time. Catalogs sent to you every three months.

Membership fee is $2.00 for 2 years and you may deduct the fee from your first order. Join today!

INTERNATIONAL RECORD & TAPE CLUB—Dept. N
315 W. 36th St. • N.Y., N.Y. 10018

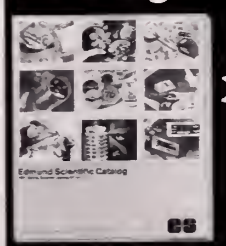
My fully deductible $2.00 membership fee has been enclosed. Mail my catalog to:

Name _____
Street _____
City _____
State _____ Zip _____

YOUR FULL SATISFACTION IS ALWAYS GUARANTEED!

Free!

Edmund Scientific Catalog



OUR 40th YEAR!

Astronomy, Microscopy, Biofeedback, Weather, Alternate Energy, Binoculars, Optics, Magnets, Magnifiers, Tools, Unique Lighting, Lab Equipment, and much more. Over 4,000 unique and fascinating products. Send for our FREE 112-page, colorful 1981 Edmund Scientific Catalog...Today!

Rush me your free catalog!

Name _____
Address _____
City _____
State _____ Zip _____

Clip And Mail Coupon Today To:
Edmund Scientific Co., Dept. 3016 E-08
Edscorp Bldg., Barrington, N.J. 08007



See and experience the Africa of Livingstone, Burton and Hemingway— on a walking photographic safari in Zambia's fabulous national parks. Viewing by open Land Rover only slightly tempers the excitement of the chase. If creature comforts matter, wilderness lodges provide all the amenities.

Tours to Zambia are arranged by:

Lindblad Travel
Maupintour
Lynott Tours
Percival Tours

Consult your travel agent, or write for brochures to:

ZAMBIA
NATIONAL TOURIST BOARD
150 East 58th Street
New York, N.Y. 10022
(212) 758-9450

ZAMBIA NATIONAL TOURIST BOARD NH-4
150 E. 58th St., N.Y. 10022
Please send brochures to:
Name
Address
City State Zip

AUTHORS WANTED BY NEW YORK PUBLISHER

Leading subsidy book publisher seeks manuscripts of all types: fiction, non-fiction, poetry, scholarly and juvenile works, etc. New authors welcomed. Send for free, illustrated 40-page brochure W-82 Vantage Press, 516 W. 34 St., New York, N.Y. 10001

ANTIQUITIES FROM THE HOLY LAND



MUSEUM QUALITY, archealagical finds. Jewelry, pattery, weapanry, glassware, statuary fram the Branze Age thraugh Byzantine periad. Certificate af Authenticity included.

W. KUHNE JACOBS
ANTIQUITIES
ASTARTE
Middle Bronze Age
1850 BC - 1550 BC
50 West 76th Street, New York, N.Y. 10023
By appointment only (212) 724-9455

BOOK HUNTING?

Virtually any book located—no matter how old or long out-of-print. Fiction, nonfiction. All authors, subjects. Name the book—we'll find it! (Title alone is sufficient.) Inquire, please. Write: Dept. 71

BOOKS-ON-FILE P.O. BOX 195
UNION CITY, NEW JERSEY 07087

pithecus just went on getting bigger, more herbivorous, and (judging from its relative abundance at Koobi Fora) more successful, until it perished of unknown causes about one million years ago. Bipedality persisted in the *Australopithecus* lineage for more than two million years without any association with big brains or stone tools. So what is bipedality good for, if not freeing the killer ape's hands for holding weapons? Johanson's tentative answer, taken from his friend and collaborator Owen Lovejoy: sex. Making babies.

Lovejoy's reasoning, which Johanson and Edey set forth in forty pages of quasi-Platonic dialogue, runs roughly as follows. Twelve million years ago, apes were common and monkeys were rare. Today, things are the other way around. What happened, in Lovejoy's view, is that the apes found themselves trapped in a pattern of natural selection that favored a progressive increase in brain size, requiring ever longer infancies and greater intervals between one birth and the next. In the time it takes a female chimpanzee to reach puberty and have her first baby, a female baboon has already raised four. Faced with this sort of competition, the apes are doomed. The hominids represent the only group of apes that has come up with a solution to this problem, namely, the two-parent family unit, in which Mom sits home lactating and gestating while Dad goes out to bring home the carrion. Bipedalism frees the hands, not so much for tool use as for hauling around helpless offspring and for carrying food. Hence our upright posture, our closely spaced births, capacity for romantic love, unflagging interest in year-round sex, and lemminglike overpopulation of the world. This view of a male-provisioned nuclear family as the cornerstone of human existence is sure to provoke a hot controversy, in which I am reluctant to participate beyond pointing out that birth spacing in South African hunting peoples and Tanzanian chimpanzees is about the same.

Johanson and Edey have written an uncommon sort of book to explain Johanson's finds and what they mean. Edey, an assistant editor at Time-Life Books, seems to have done most of the writing. Despite this, the book is written in an "I, Don Johanson" format, like an as-told-to biography of a film star. This artifice made me grate my teeth for about the first ten pages; then I got interested and forgot about it. The book is partly a professional memoir, partly a compressed history of paleoanthropology, and partly a popular treatment of current knowledge and guesses about human evolution. These three strands of the book loop in and out of each other in a fluid and ingratiating way that is obviously the work of a professional writer who knows his stuff. The scientific exposition is fascinating, thorough-going, and easy to follow; even complete novices will find themselves picking up a surprisingly detailed understanding of everything from potassium-argon dating to the importance of the ectostylid in identifying fossil horse teeth. The authors have seized on the increasingly popular gimmick of using dialogue to put across technical points in colloquial language. This works well as long as the reader doesn't start wondering how on earth Johanson got a verbatim transcript of a chat Clark Howell had with Louis Leakey in 1965. The passages recalling the history of paleoanthropology are a delight to read. Even jaded professionals will enjoy Basil Cooke's explanation of what "MCP" stands for, or Robert Broom's remark that a col-

international nature tours



Galapagos Islands/ Headwaters of the Amazon/Ecuador/ Peru/Patagonia/ Falkland Is./Kenya Tanzania/Rwanda Gorilla Safari/Costa Rica/Nepal/New Guinea
Expert Naturalist Guides
Very Small Groups

Write: **WILDERNESS TRAVEL***
1760-NJ Solano Ave., Berkeley, CA 94707
(415) 524-5111
**formerly So. American Wilderness Adventures*



BOOKS PUBLISHED

National book publisher can print your book for as little as 18c per copy (paperback, 100,000 copies). For further info write: Regal Press Inc., 4555 W. Lovers Lane, Dallas, Texas 75209 or call (214) 353-9913.



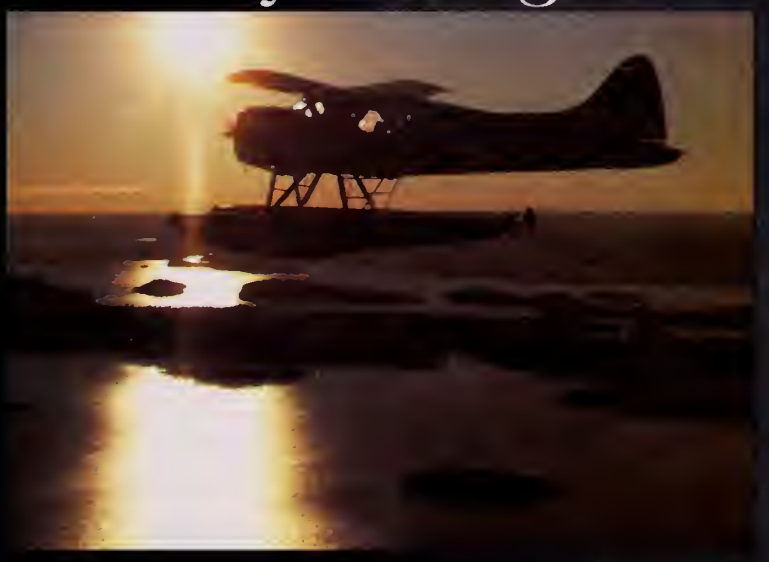
league's brain "was remarkably good for its size."

Fossil hominids have always been the number-one glamour stock on the paleontological bourse, bringing their discoverers fame and fortune of a sort forever denied to those who study extinct clams. It is no wonder that people who work on fossil hominids are notorious for the intensity and bitchiness of their rivalries. Johanson and Edey's book shows us some of these rivalries from Johanson's point of view, and the descriptions of his antagonists are not flattering. Richard Leakey, for example, is introduced as an "obscure bushwhacker" who spurned a university education to become a white hunter and safari guide, stumbled across Koobi Fora in a snit while evading distasteful work at another dig, and barred Tim White from Koobi Fora when he dared to voice a dissenting opinion about the date of the 1470 skull. Happily, Johanson can take it as well as dish it out. Even Richard Leakey would probably relish the quotes from White describing Johanson as "a nail-polish salesman . . . who wears Gucci loafers and Yves Saint Laurent pants." Nevertheless, Richard and Mary Leakey, Solly Zuckerman, Jon Kalb, and four or five other anthropologists are going to get no pleasure out of reading this book.

The rest of us will. In the present dark days, when impassioned ignoramuses across the country are marshaling their forces to get Noah's ark put into the Constitution, a book like this is of enormous value. Entertaining and informative without being condescending, it will give any fair-minded reader an enlightened understanding of the vast mass of minutely detailed evidence that underlies our knowledge of human evolution, and of the hard physical and intellectual work that has gone into piling up that evidence. Evolutionary biologists, whose currently intense arguments over theoretical fundamentals have hamstrung them in fending off the onrush of the Bible-thumpers, should welcome a book like *Lucy*. It puts across the excitement and headaches of studying human evolution and does the job with conviction, accuracy, and pizzazz. This book needs to be on our new President's bookshelf.

Matt Cartmill is professor of anthropology and anatomy at Duke University.

Fly Fishing

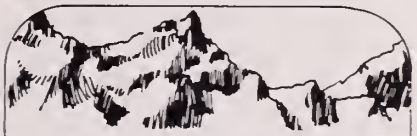


Northern Saskatchewan

Lake after lake after countless lake. Untouched land. Freshly caught walleye or pike cooked over a campfire. Come on up.

Canada

SO MUCH TO GO FOR



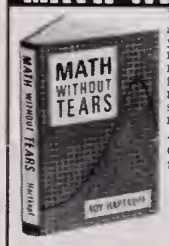
University of California, Santa Cruz

JOIN A WILDLANDS RESEARCH TEAM IN THE MOUNTAIN WEST OR CANADA

- Wildlife Research
- Wildlands Research
- Wild River Research

SUMMER, 1981
Field Courses, 5 Units
Phone (408) 429-2822 or write:
WILDLANDS RESEARCH INSTITUTE
Cardiff House
University of California Santa Cruz
Santa Cruz, CA 95064

MATH WITHOUT TEARS



Using non-technical language and a light touch Roy Hartkopf gives you a basic understanding of many everyday applications of mathematics. He takes the reader from simple counting to trigonometry and calculus, emphasizing the practical aspects of math. Humorously written. *Learn math in the comfort of your own home at minimum cost.*

Order Now: $9.95 plus 95¢ hdlg.
EMERSON BOOKS, INC.
Dept 626-F Buchanan, N.Y. 10511
10 Day Money Back Guarantee

Share the Thrills of Exploring Outer Space!



$359.95 f.o.b. Hartford, Conn.
$15 Crating Charge

Now it's easy to join the thousands of serious amateurs who have discovered the excitement of exploring our mysterious universe. Your enjoyment begins right from the start, yet the challenges and rewards go on for years! And it's a hobby that can be shared at modest cost.

Choose From Many DYNASCOPES®

Picking a telescope to fit your needs and your pocketbook is simple when you select a DYNASCOPE—the same instruments used by more than 150 schools, colleges and observatories—and your satisfaction is guaranteed by a full-refund warranty.

FASCINATING GUIDE YOURS FREE!

Read these valuable facts before buying any telescope. Mail coupon or postcard for your complimentary copy of this helpful guide.



Criterion Manufacturing Co.
620 Oakwood Ave. W Hartford, Conn. 06110

® TM Registered U.S. Pat. Office

CRITERION MANUFACTURING CO., Dept NH 102
620 Oakwood Avenue, W Hartford Conn 06110
Please send your free Telescope Guide.
Name_____
Address_____
City_____ State_____

Chili con Blarney

The annual Texas chili cookoff is a bizarre and boozy food event

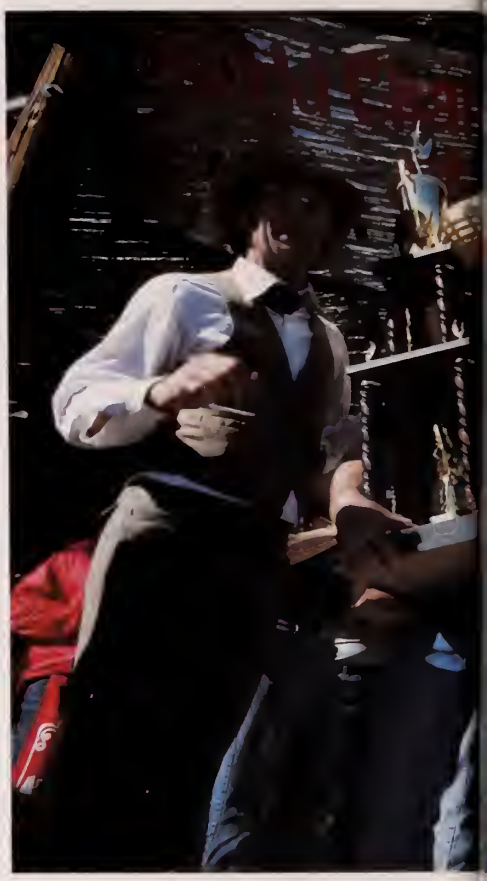
by Raymond Sokolov

Looking like a giant egg with eyebrows, a stranger came up to me in the lobby of an Austin, Texas, motel in 1971, proferring a plain, brown carton. I looked puzzled. He showed me his driver's license, which was Vietnamese, but gave his name as Wick Fowler. The carton contained several packets of premixed spices boldly labeled "Three-Alarm Chili." Fowler had created the jocular product to capitalize on his fame as the chief cook of the Chili Appreciation Society International (CASI), an outfit that sponsors the Annual World Championship Chili Cookoff in a Texas mining ghost town called Terlingua.

Fowler was not profaning the pristine sanctity of the Terlingua cookoff. His chili mix was by no means contemptible. And self-advertisement lies at the heart of the cookoff itself, which began as a publicity stunt in 1967. A Dallas restaurateur and journalist, Frank X. Tolbert, had concocted the contest to promote the sale of his book, *A Bowl of Red: The Natural History of Chili with Recipes*. Originally, Tolbert had planned to pit Fowler against Dave Chasen, the Beverly Hills restaurateur, whose chief stirrer was to have been Elizabeth Taylor. But Chasen fell ill, and the humorist H. Allen Smith of Mount Kisco, New York, author of a boastful mock attack on Texas chili cooks, stood in for him.



photographs by Adelaide de Menil



The result was called a draw, but the cookoff itself was a decisive success, spawning what Tolbert has called "an international subculture" involving thousands of "chili heads" who compete in CASI-sponsored local tourneys from Manila to Connecticut. Winners trek to Terlingua on the first Saturday in November for "the big showdown," which is probably the biggest, grossest, booziest, most self-inflated, and certainly most entertaining of all the thousands of American regional food events that each year purport to commemorate and preserve the hallowed and embattled dishes of yesteryear.

Second to none in my hunger for authentic American food, I traveled to Terlingua for the 14th Annual Wick Fowler Memorial World Championship Chili Cookoff. Getting to the remote patch of desert on the banks of the Rio Grande where the contest is held isn't easy. Essentially, you drive through the 8,000-foot, lunar Chisos Mountains in the Big Bend National Park, and turn right. Road runners skitter and bob across the highway. The sky is big, and the nearest town of consequence, Alpine, is eighty miles away. For cookoff weekend, Alpine's motels are full, all their rooms having



been reserved several weeks in advance. There aren't really many other places to stay in the rest of Brewster County, the state's largest, which at 5,935 square miles is bigger than Connecticut and very empty.

A century ago, when its mines provided 40 percent of the country's cinnabar, or mercury ore, Terlingua itself had 2,000 or so inhabitants. But foreign competition closed the mines, and only four permanent inhabitants remained when CASI staged the first cookoff. By now, however, the word has spread worldwide. On cookoff weekend, Terlingua hosts hundreds of chili heads and camp followers who arrive with tents and vans for the rowdiest weekend this side of Fort Lauderdale.

The contest site looked like a Hollywood mock-up of a Western town. But the real-life action was a bit more "adult" than the movie industry tends to allow. Dancers in Old West costumes gyrated at the Ball Buster Bar. They were the show business aspect of the Ball Buster Chili team. The cookoff gives an award for the best variety act of the day, which explained the frontier revival church in full swing at one end of the patio. Brother Willie and Sister Lilly's Salvation Chili team led the pagan hordes in a hymn sung to the tune of "Amazing Grace": "Salvation chili came to me/ And saved my soul from grief./ It cured my pimples, healed my toe/ And put me on relief. . . ."

The crowd was dressed in a variety of costumes, ranging from obscene T shirts to the height of urban cowboy dandyism—an all-rattlesnake-skin vest decorated with several huge rattles and fossilized shark's-teeth all set about with turquoise and silver. The crowd, restless with anticipation and primed with Texas beer, gathered to watch young women vie in a wet T-shirt contest and young men take their pants off for the "equal opportunity" hairy legs competition. At the height of the frenzy, a voice on the public address system announced: "Matt Butler lost his pistol. Nickel-plated. Whoever finds it, there's a reward. If that's necessary."

Meanwhile, at the edge of the festivities, a motley collection of men and women were devoting themselves with solemnity to the preparation of chili. For them it was a serious day of judgment.

Connecticut champ Jim Hibbits, wearing a frock coat and top hat, stirred and tasted his Ugly Butcher Chili. Wayland Walker of Ardmore, Oklahoma, told passers-by how he had turned to chili out of desperation, when a slaughterhouse miscut a whole beef he had purchased from the local sheriff. Some sixty contestants labored over their pet chilis all through the forenoon, hoping that greatness would be thrust upon them by the CASI judges. Most of the cooks used whole chili peppers, not prepared powder. And they followed CASI rules, which insist on beef and forbid all vegetables except onions. This not only eliminates exotic ingredients such as pineapple but also excludes beans. At Terlingua, beans are viewed with alarm, as a contaminant of what Texas governor Bill Clements hailed in an official proclamation as "unadulterated Texas chili."

My own random tasting of the chilis-in-progress reminded me how much variation there can be on an apparently simple culinary idea. Even with the CASI restrictions, no two chilis tasted alike. Recondite spice combinations and varying dosages produced a wide spectrum of flavors, as well as levels of hotness ranging from mild to infernal.

Judges assembled at lunchtime on a protected upper level and began their tongue-singeing task, clearing their palates with beer between tastes, doing their best to rate each entry on a ten-point scale based on five criteria: aroma, red color, consistency, taste, and aftertaste.

No one disputed their final decision to award the world championship to Brother Willie and Sister Lilly's Salvation Chili. But any objective bystander who had not entirely succumbed to the soporific powers of Texas sun and brew was left wondering what it all meant. Was Terlingua merely a ribald exercise in boosterism and self-parody or did the cookoff really help to maintain the purity of one of the nation's best known and most polymorphous regional dishes?

At issue is the whole vexing notion of authenticity in food. CASI's rules are a laudable attempt to codify and preserve what one of its members asserted to me was an invention of the frontier, a simple beef stew seasoned with regionally abundant capsicum (chili) peppers and other spices (usually cumin, oregano, and garlic) and onions (see recipes). Also, the Ter-

lingua chili heads are certainly right to abominate *outré* variations such as Cincinnati three-way chili or the bland bowls of ground meat and beans served at every nondescript lunch counter in the land.

On the other hand, all the Lone Star chauvinism at Terlingua overlooks certain obvious factors that must have contributed to the evolution of chili con carne. The dish obviously did not originate entirely among English-speaking Texas ranchers. The influence of Mexico, within sight across the river from Terlingua, shows itself in the part-Spanish, part-Nahuatl name. "Chili" is a descendant of the Aztec term for capsicum peppers. And it simply must be the case that modern chili arose through the contact of nineteenth-century white immigrants with native Indians and Mexicans. This of course is where all of the so-called Tex-Mex foods began. Chili is merely the most popular among them, mixing the Mexican tradition of sauces flavored with chili (and other spices typical of Mexican food) with the European notion of a beef stew based on chunks of browned meat.

All through the American Southwest different variations on the same theme have sprung up and prospered. Consider chili with beans, green chili made from green chili peppers, or chili with ground meat. You will find chili served at Indian pueblos and at the Tigua Indian Reservation in El Paso. There is even quite "authentic" chili in Arizona and other non-Texas locations in the Southwest.

To be fair, the Terlingua cookoff is not purely isolationist. It promotes the worldwide proliferation of its kind of chili. But the motive behind CASI is still intrinsically self-contradictory. CASI wants to protect traditional Texas chili, as if it were a dish handed down over generations by a coherent culture, fixed as to its ingredients and style of preparation in one basic ancestral recipe. But the very essence of chili con carne is its cultural diversity and lack of culinary fixity. At Terlingua, the chili heads, while claiming to preserve a traditional recipe, are in fact trying to create one. So remember, the next time you start to put beans in your chili, the eyes of Texas are upon you.

Raymond Sokolov, a writer with an interest in the history and preparation of food, is editor of Book Digest.



Frank X. Tolbert's "Simplified Texas Chili"
(Adapted from a text in *Flying Colors* Magazine)

- 3 pounds lean beef
- 2 ounces suet (or substitute vegetable oil)
- 2–4 chilis anchos
- 2 tablespoons cumin
- 1 tablespoon oregano
- ½ cup paprika
- 1 tablespoon cayenne (optional)
- 1 sprig fresh coriander (cilantro), chopped
- ⅓ cup finely chopped garlic

1. Cut the beef into bite-sized chunks.
2. Render the suet in a heavy skillet, and sauté the beef chunks until they turn gray.
3. Pour the liquid from the skillet into a heavy pot, leaving a small amount in the pan. Continue cooking the meat until it is well browned on all sides.
4. Meanwhile, remove stems from chilis and purée in a blender with a small amount of water. Add purée to chili pot.
5. When meat is browned, add it to the chili pot and simmer for 30 minutes.
6. Add remaining ingredients and simmer for another 30 minutes or until meat is tender. (Use choice chuck. That old myth about bull meat is not for the Tolberts.)
7. Keep the chili overnight; in the morning, scrape off the grease that comes to the top.

Yield: 6–8 servings

Lone Star Texas Chili with Beans

- 2 tablespoons vegetable oil
- 2 pounds stewing beef, cubed
- 1 cup chopped onions
- 1 green bell pepper, seeded and chopped
- 1 clove garlic, minced
- 1 12-ounce can tomato paste
- 2½ cups water
- 2 pickled jalapeño peppers, rinsed, seeded, and chopped
- 1½ tablespoons chili powder
- ½ teaspoon crushed red pepper
- ½ teaspoon salt
- ½ teaspoon dried oregano
- ½ teaspoon cumin
- 1 15½-ounce can pinto beans, drained

1. In a large, heavy pan, heat oil and brown beef cubes on all sides. Add onions, bell pepper, and garlic and fry with beef for about 5 minutes.
2. Add all the remaining ingredients except beans, and simmer the chili for 1½ hours or until the meat is tender.
3. Add beans and simmer 30 minutes longer.

Yield: 4–6 servings



Things of quality have no fear of time.

Time is the enemy of all things made. It weakens. It lessens. It wears out the most carefully-built products.

But as a maker of home appliances, Whirlpool Corporation believes there are ways of taking the sting out of time. Taming it to a point where it's always respected, but never feared.

We know the real challenge comes after the sale. When new becomes used. And used becomes old. This is why we take pride in stocking parts for as many years as we do. And why we maintain a toll-free Cool-Line® service number* you can call 24 hours a day. And why we have a nationwide organization of authorized Tech-Care® service companies that are as close to you as your phone book.

You see, at Whirlpool we believe quality is not something to be flicked on and off like a neon sign. We believe it should be a philosophy of excellence dedicated to one person—you.

It's our way of saying this is more than just an appliance. This is our way of life.

Whirlpool
Home Appliances

*800-253-1301 In Alaska and Hawaii 800-253-1121 In Michigan 800-632-2243

THE TASTE BEYOND 12-YEAR-OLD SCOTCH



Discover more.

Let your mature taste lead you from the finest premium Scotch on up to the most expensive 12-year-old Scotch in the world. The Glenlivet. The ultimate in Scotch.

Most premium Scotch is blended and depends on several whiskies for taste and smoothness.

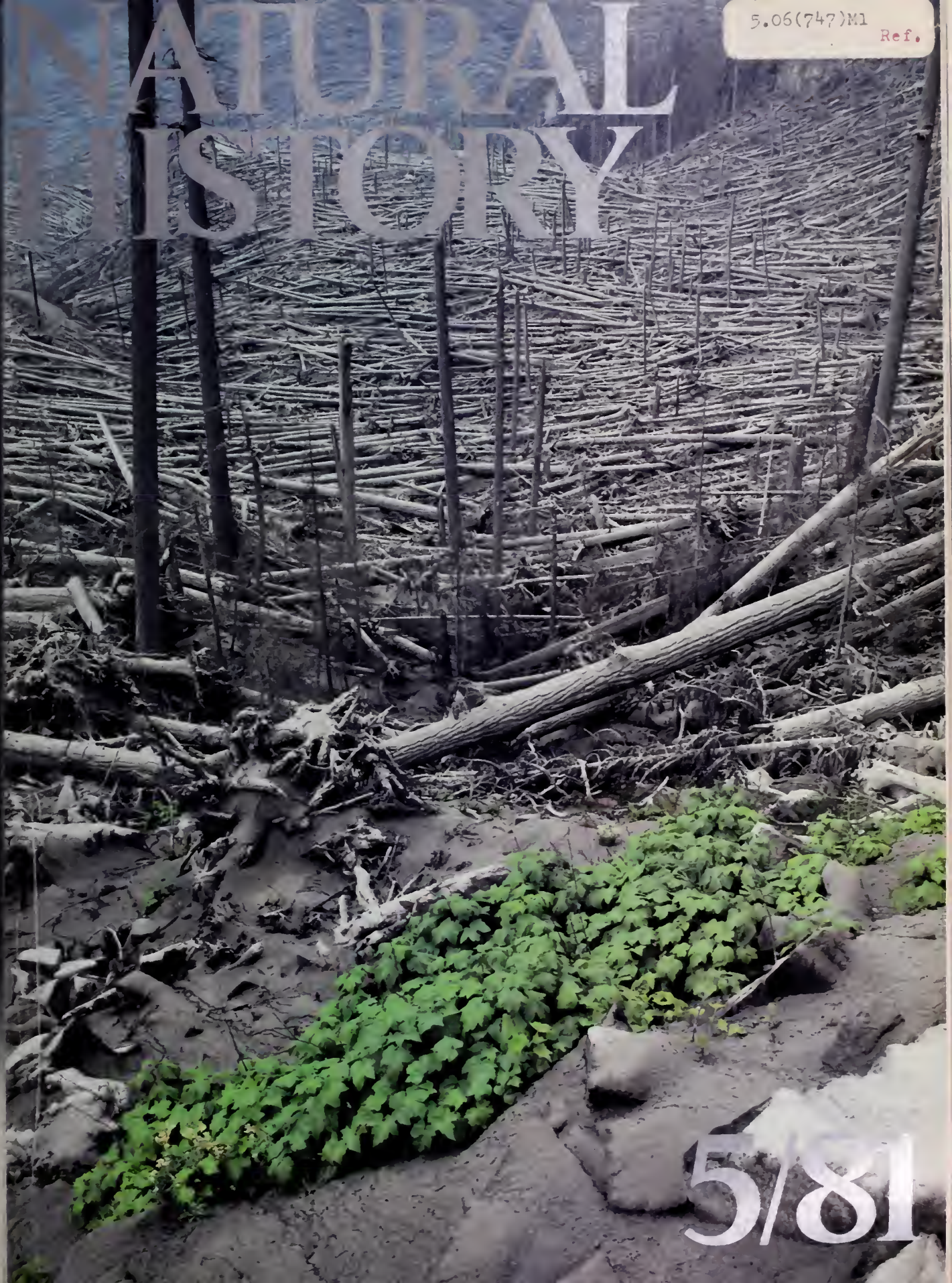
Yet the unblended character of The Glenlivet is noble enough to stand alone. In this distinctive Scotch whisky you'll experience an exceptional smoothness and full-bodied richness, unmatched in all other premium Scotch.

Try the taste beyond premium Scotch.

The Glenlivet
Unchanged since 1824.

5.06(747)M1
Ref.

NATURAL HISTORY



5/81





photos Pesin





Waterford® Won't Spill The Beans.

The reigning passion. Jellybeans under glass. Legendary glass by Waterford. Give it to the executive you adore. Indulge him. Or her.

NATURAL HISTORY

Vol. 90, No. 5, May 1981

American Museum of Natural History
Robert G. Goelet, President
Thomas D. Nicholson, Director

6 Authors

12 The Web of Hunger *T. Colin Campbell*
More Is Not Necessarily Better

20 This View of Life *Stephen Jay Gould*
The Titular Bishop of Titiopolis

26 The Tourist as Pilgrim *Colin Turnbull*
East African Safari

36 Life Returns to Mount St. Helens *Roger del Moral*
For many living things, natural catastrophes are neither new nor overwhelming.

50 Steady as a Rock, Fast as Lightning *Text and photographs by David B. Grobecker*
An Indo-Australian fish has evolved remarkable camouflage, fishing, and eating habits.

54 Good Dugong, Bad Dugong; Bad Turtle, Good Turtle
Bernard Nietschmann and Judith Nietschmann
Because they are isolated off northern Australia, sea turtles, dugongs, and marine hunters survive.

64 A Martin House Is Not a Home *Erik J. Bitterbaum and Charles R. Brown*
These birds don't share our notion of a proper life style.

70 Celestial Events *Thomas D. Nicholson*

72 The Earliest Traces of a Conservation Conscience
Robert M. Alison
As civilizations advance, their protection of natural resources grows.

78 Sky Reporter *Stephen P. Maran*
A Nonconforming Supernova

84 At the American Museum
Frozen Fish

86 Additional Reading

88 Books in Review *Joseph Kastner*
Beastly Rights

92 A Matter of Taste *Raymond Sokolov*
Olympic Trials

Cover: *A healthy patch of thimbleberry,* Rubus parviflorus, *grows through volcanic ash only four months after the eruption of Mount St. Helens devastated the surrounding forest. Photograph by John Marshall. Story on page 36.*

Alan Ternes, Editor
Judith Friedman, Managing Editor
Thomas Page, Designer
Board of Editors:
Sally Lindsay, Frederick Hartmann, Vittorio Maestro, Rebecca B. Finnell
Carol Breslin, Book Reviews Editor
Florence G. Edelstein, Copy Chief
Rita Campon, Copy Editor
Angela Soccodato, Art Asst.
Kay Zakariasen, Picture Editor
Douglas J. Preston, Publications Editor
Susan Rosenberg, Editorial Asst.
Lillian Berger
Editorial Advisers:
Malcolm Arth, James W. Atz, Niles Eldredge, Kenneth L. Franklin, E.Craig Morris, Norman Newell, Thomas D. Nicholson, Martin Prinz, Gerard Piel, Nina Root

David D. Ryus, Publisher
Bradford D. Smith, Business Manager
Frederick E. Grossman, Production Mgr.
Debra Buck McCord, Asst. Production Mgr.
Ernestine Weindorf, Administrative Asst.
Elaine M. Callender, Advtg. Production Mgr.
Lauren Krenzel

Daniel J. Dynan, Asst. Circulation Mgr.
Bob Bruno, Fulfillment Mgr.
Ramón E. Alvarez, Circulation Asst.

Natural History *(ISSN 0028-0712), incorporating Nature Magazine, is published monthly by the American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024. Subscriptions: $15.00 a year. In Canada and all other countries: $18.00 a year. Second-class postage paid at New York, N.Y. and at additional offices.*

Copyright © 1981 by American Museum of Natural History. All rights reserved. No part of this periodical may be reproduced without written consent of Natural History. *The opinions expressed by authors do not necessarily reflect the policy of the American Museum.* Natural History *is indexed in* Reader's Guide to Periodical Literature.

Advertising Offices:
Natural History Sales
488 Madison Avenue
New York, N.Y. 10022
President of Sales, Arthur Hill Diedrick
Advertising Manager, Katherine José

Telephone Numbers:
Advertising Sales (212) 826-9467
Museum Information (212) 873-4225
Subscription Orders (800) 526-0331 outside N.J.
(800) 932-0834 in N.J.

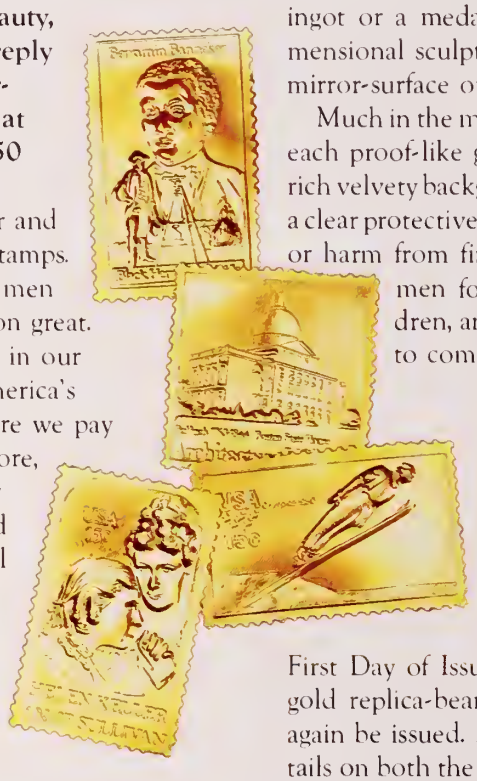
Change of address notices, undeliverable copies, orders for subscriptions, and other mail items are to be sent to
Natural History Membership Services
Box 4300
Bergenfield, New Jersey 07621

Now...an exact 22kt gold replica will be created for each new U.S. Commemorative Postage Stamp!

22kt Gold Replicas of United States Stamps

Exact replicas on a gleaming surface of real gold.

Under a non-exclusive licensing agreement with the U.S. Postal Service, the Postal Commemorative Society is proud to make available an authentic replica of each new U.S. Commemorative Stamp—recreated to exacting standards with high-relief sculptured detail on a flawless, mirror-smooth gold surface. Accompanying each mint-perfect replica is the actual stamp, cancelled with the Official First Day of Issue Postmark. The result is a collectible of unsurpassed meaning, beauty, and importance. And, if you reply promptly, you have the opportunity to start your collection at the favorable price of just $5.50 each.



Nothing captures the grandeur and glory of this land like America's stamps. For here is where we honor the men and women who made this nation great. Where we relive the high points in our history. Where we rejoice in America's magnificent natural beauty. Where we pay tribute to our customs and folklore, institutions and ideals. Each new stamp is a patriotic treasure. And each is also an important original work of art—created by one of America's finest living artists.

Imagine the excitement, then, when each new stamp is immortalized on a gleaming surface of 22kt gold!

Each 22kt gold stamp replica will be authentic down to the smallest detail.

For each new commemorative stamp that is issued, the U.S. Postal Service makes available a photograph of the original design. From this photograph, the stamp is then recreated on sheets of paper-backed 22kt gold precisely to the original's size, shape, and official design.

First, the skilled craftsman hand-inscribes every line and stroke of the original in raised relief upon a master model from which a die is created. The die is then used to strike the 22kt gold surface in a flawless proof-like finish—just as if one were producing a magnificent medal or coin. The result is not an ingot or a medallion—but a dramatic, three-dimensional sculpture, standing in high relief on a mirror-surface of gleaming gold!

Much in the manner of a precious medal or coin, each proof-like gold replica is displayed against a rich velvety background—and preserved forever in a clear protective capsule to guard against dust, loss, or harm from fingerprints. A perfect mint specimen for your children, your grandchildren, and their children to enjoy in years to come.

The actual First Day of Issue Stamp attests to the faithfulness of the replica!

Perfectly complementing the gold stamp replica is the actual stamp—bearing the Official First Day of Issue Postmark to certify that these gold replica-bearing First Day Covers can never again be issued. As you examine the intricate details on both the stamp and its replica, you will see how perfectly the two correspond!

A custom-crafted collector's album will showcase your collection to best advantage.

Your name will be stamped in gold on the front

22KT GOLD REPLICA. Not an ingot or a medallion but an exact replica of a U.S. Commemorative Postage Stamp, struck on a gleaming surface of 22kt gold.

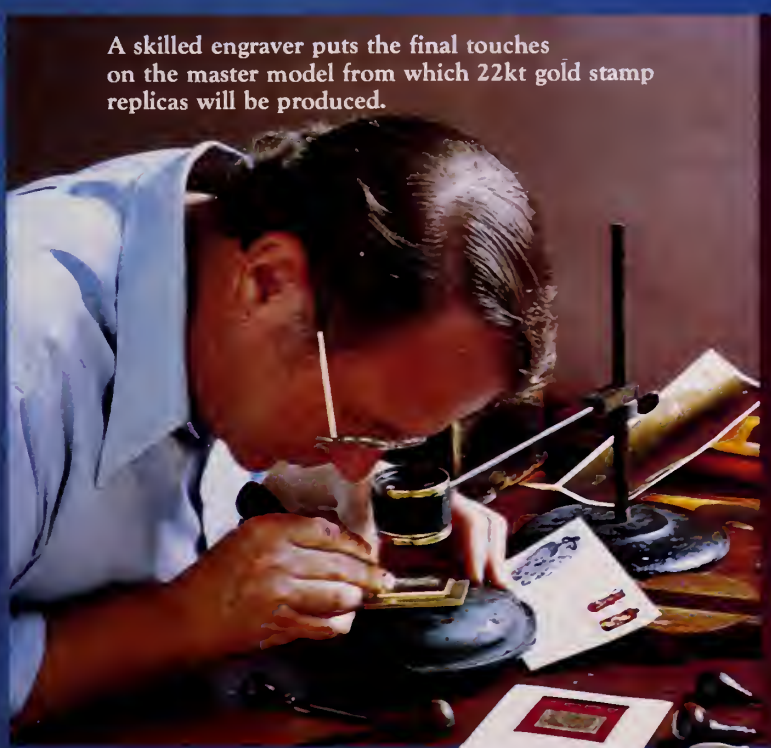
OFFICIAL FIRST DAY OF ISSUE POSTMARK, certifying each cover as an Official First Day Cover, which can never again be issued.



PROTECTIVELY ENCAPSULATED to guard against dust, scratches, and fingerprints. Each gold stamp replica is permanently sealed in the cover and set against a rich velvety background.

PERSONALIZED with your name and address, if desired.

THE OFFICIAL U.S. COMMEMORATIVE POSTAGE STAMP—which is the basis for each 22kt gold replica.



A skilled engraver puts the final touches on the master model from which 22kt gold stamp replicas will be produced.



A final striking is inspected to insure that it meets the high quality standards established for 22kt Gold Replicas of United States Stamps.

(continued on next page)



Covers shown smaller than actual size.

NOTE: The stamps and replicas shown in this presentation are from past issues and are shown for illustrative purposes only. You will receive replicas of future U.S. Commemorative Stamps as they are issued.

(continued from previous page)

cover. Inside, transparent vinyl pockets will display each cover. You may slide each cover from its pocket for closer inspection and still not worry about the gold stamp replica itself—sealed within its own protective capsule.

Subscribe now for a favorable issue price.

Subscribing before the end of the current enrollment period guarantees that you will be enrolled at the favorable issue price of $5.50 per cover. This price includes the gold stamp replicas, the protectively sealed capsules, the First Day of Issue stamps, the official postmarks, the display pages, the clear vinyl pockets, and your personalized collector's album. The value is all the more remarkable when one notes that other covers bearing gold stamp replicas have been offered to collectors for more than twice the price!

No payment needed now.

You need send no money now. Simply return the application on the right before July 31, 1981. As a subscriber, you can expect to receive your covers approximately 8 to 10 times each year, depending on the Postal Service's schedule of new commemorative releases, with 3 covers per shipment. You will be billed with each shipment.

Join us for this magnificent philatelic tribute to the greatness of America—a collection that surpasses anything previously seen. A collection that you and your family will treasure for untold generations to come!





American Folk Art Series
Pennsylvania Toleware



Folk Art USA 15c

FIRST DAY OF ISSUE

LANCASTER, PA APR 19 1979 17604

Mr. John H. Jones
455 Main Street
Anywhere, U.S.A. 12345

Stamp Design ©1979 U.S. Postal Service

Subscription Application 660

22kt Gold Replicas of United States Stamps

Postal Commemorative Society
47 Richards Avenue
Norwalk, Conn. 06857

Guaranteed acceptance
at the price quoted herein only
if postmarked by July 31, 1981

Please enroll me as a subscriber to **22kt Gold Replicas of United States Stamps.** I will receive a gold stamp replica for each and every new U.S. Commemorative Stamp. I can expect to receive my gold stamp replicas approximately 8 to 10 times each year (depending on the U.S. Postal Service's schedule of new commemorative stamp releases), in sets of three each.

I will be billed $5.50 (plus $.50 shipping and handling) for each gold stamp replica. I will be billed as each shipment is sent to me. A custom collector's album will be sent to me at no additional charge. I understand that either party may cancel this subscription agreement at any time.

☐ As a convenience, I prefer to have my 22kt Gold Stamp Replicas charged, at the time of shipment, to my:
☐ Master (Charge) Card ☐ VISA

Credit Card Number _____ Expiration Date _____

I would like my covers:
☐unaddressed, or ☐personalized exactly as shown at right.

Mr. Mrs. Miss _____

Address _____

City, State _____ Zip _____

Signature _____

Allow 10 to 12 weeks for shipment of initial set.

When Mount St. Helens erupted on May 18, 1980, **Roger del Moral** added the recovery of subalpine vegetation on the mountain to his research interests, which also include competition within stable alpine herb communities. "Upon hearing that a new environment had been made available for plant colonization," he says, "I could not refuse such a unique opportunity to follow how ecosystems reconstitute themselves." An associate professor of botany at the University of Washington at Seattle, del Moral has done fieldwork in Washington, California, Alaska, and eastern Australia. He enjoys landscape and vegetation photography, and when not studying the often eerie, alien landscapes of Mount St. Helens, he reads science fiction.





David B. Grobecker was hooked on anglerfish the first time he saw one in a tropical fish store. Currently a Ph.D. candidate and research associate at the College of Fisheries of the University of Washington, he is working on the morphology and feeding ecology of Antennariidae anglerfish. An interest in predatory behavior has led him to study other fishes that employ a lie-in-wait strategy, including the stonefish and carpet sharks. A fisherman himself, Grobecker is also a photography enthusiast. By means of high-speed, light cinematography, at 800 and 1,000 frames per second, and a generous measure of patience, he has been able to document the extraordinarily fast feeding mechanisms of some anglerfish.



THE KEEPERS
of the Ornsay Light
take a day or two off
each week.
But haven't had
a night out since 1857.





The good things in life
stay that way.
Dewar's® never varies.

Authentic.
The Dewar Highlander

BLENDED SCOTCH WHISKY • 86.8 PROOF • ©1980 SCHENLEY IMPORTS CO., N.Y., N.Y.



This is the land of the Vikings.

And this could only be Rio de Janeiro where the carnival pace picks up when the sun goes down.

South America.

The world's fourth largest continent. A land of mystery. Fantasy. A marvelous mélange of Indian, colonial, and contemporary European cultures. And who could show you South America better than the Royal Vikings? For we carry you to more ports, more places, more pleasures than any other cruise line on earth.

This fall we'll take you down one coast and up the other. Through the Strait of Magellan and the Panama Canal.

And though you may not find a lost Inca treasure, you may indeed return with emeralds from Colombia, pearls from Venezuela, fleecy alpaca slippers from Peru. Or a craving for the delicate langostinos (tiny crawfish) of Chile.

You'll bring home memories too. Of sophisticated cities like Lima and Valparaiso. Avant-garde Buenos Aires. Uninhibited Rio where beautiful, sun-bronzed Euro-Latins move to a different beat.

You'll sail on the Royal Viking Sky, of Norwegian registry and spirit. Our extraordinary World Class™ service means relaxed, single seating at every meal. Double cabins, nearly all outside, that look to sky and sea. And a crew that will welcome you as warmly as they would a Scandinavian summer.

Around South America sailings: Round trip from Los Angeles/San Francisco, 58 days, Oct. 15/16, calling at Acapulco and Puerto Vallarta along the golden, glittering Mexican Riviera. Plus Callao, Valparaiso, Puerto Montt, Punta Arenas, Buenos Aires, Rio de Janeiro, Salvador. Bridgetown on the Caribbean island of Barbados. Then Cartagena and Balboa.

Round trip from Florida, 63 days, Sept. 28. Or New York to Florida, 66 days, Sept. 25. These two cruises call at St. Thomas, St. John's, La Guaira, Zihuatanejo, and all ports listed above except Cartagena and Balboa.

For more information or reservations, see your travel agent. Or write Royal Viking Line, Dept. K-38, One Embarcadero Center, San Francisco, CA 94111. Then set sail for South America. It's been waiting centuries for you.

ROYAL VIKING LINE

1981 Around South America Cruise



NATURAL HISTORY
Magazine

YES, send me 12 color-packed issues of NATURAL HISTORY Magazine, along with the bonus supplements, and make me a member of the American Museum of Natural History, giving me free admission and discounts at the gift shop, for just $15.

I realize I am always free to cancel at any time for any reason and receive a full refund for all the unmailed issues.

☐ I prefer to save by ordering 2 years for just $26.

Name_____

Address_____

City_____

State_____ Zip_____

☐ New ☐ Renewal

Name_____

Address_____

City_____

State_____ Zip_____

I prefer to give: ☐ 1 year at $15 ☐ 2 years at $26

Please allow 7 weeks for delivery of your first copy.
Outside U.S.A. add $2 per year for postage.

J469

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO. 30 BERGENFIELD, NJ

POSTAGE WILL BE PAID BY ADDRESSEE

NATURAL HISTORY

P.O. Box 4200
Bergenfield, N.J. 07621

Or
K-38,

sail

ruise

The husband-and-wife team of **Bernard Nietschmann** and **Judith Nietschmann** has ranged far afield in pursuit of anthropological and geographical studies. Mexico, Nicaragua, Peru, the Cayman Islands, the Pacific, and Australia have been the sites of their fieldwork, much of it concerned with cultures based on marine subsistence economies. Their studies of the Torres Strait Islanders' traditional knowledge of marine environments and biota were begun in 1976/77 and continued in 1980. Bernard is a professor of geography at the University of California at Berkeley; Judith is a postdoctoral fellow in the Medical Anthropology Program at the University of California at San Francisco. The author of many articles for *Natural History*, Bernard most recently contributed "The Wind Caller," which appeared in March 1977.

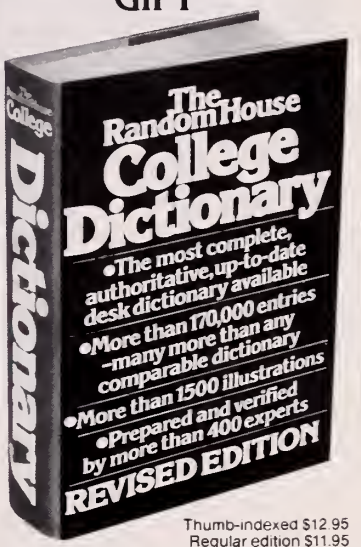


A doctoral candidate in the Department of Zoology at the University of Florida, **Erik J. Bitterbaum** (below, left) is completing a study on the comparative behavior of three species of swallows in the genus *Progne*. His work focuses on communication, with the objective of determining how vocal and physical displays function in the social behavior of closely related species having known differences in morphology and biology. Some light may be shed on how social behavior has evolved in these species. During his fieldwork in Mexico, Trinidad and Tobago, and Florida, Bitterbaum has become a purple martin fancier.

Coauthor **Charles R. Brown** (below, right) is a senior at Austin College in Texas, and will begin graduate work in zoology in September. He became interested in purple martins as a child when they occupied a backyard birdhouse installed by his father, and has followed the birds throughout Texas ever since. Brown, who began researching the breeding biology and behavior of purple martins in 1972, published his first technical paper on purple martins at the age of fourteen. Since then he has authored more than twenty papers on these birds. Species relationships among swallows will be the thrust of his future research.



THE Smart GIFT



Thumb-indexed $12.95
Regular edition $11.95
Deluxe edition $14.95

Now at your bookstore RANDOM HOUSE

Publishers of *The Random House Dictionary of the English Language, Unabridged Edition*



IT ONLY *LOOKS* HARD...

... but it's really easy!

The secret's in our kits—imported from Europe—where these historic ship models are hand-crafted in walnut and rich woods by some of the finest model makers in the world. Solid brass cast bronze and detailed wood fittings are used throughout. The hard work is done for you—most parts are *pre-cut*. Assembly is simple as you follow step-by-step instructions and large scale plans. Everything you need to complete is included, and we guarantee satisfaction.

Even if you have never built a ship before, send for our full-color catalog. See how easy it can be to build a museum quality model you will display with pride in home or office. Only $1.00.



Mail This Coupon Today!

MODEL EXPO, INC.
23 Just Road, Fairfield, N.J. 07006 Dept. NH-51

Please send full-color catalog. $1.00 enclosed.

Name

Address

City State Zip

PRESENTING OUR NEW CAMERA

When it comes to competition, the new Minolta XG-M stands alone.

How can we say that?

Simple. No other 35mm SLR in its class has its unique combination of creative features, yet is so easy to use.

All you do is point, focus and shoot. The automatic XG-M does everything else to give you clear, sharp, beautiful pictures.

It even has electronic features to prevent mistakes. And advanced features like manual metering for advanced photographers.

To separate it further from the competition, we gave the Minolta XG-M something you only find on more expensive cameras. The option of professional motor drive, to let you take pictures at an incredible 3.5 frames per second.

So you can capture fast action. Like a diver's twisting entry into the water. Or a racer's moment of triumph at the finish line.

And when you hold this camera you'll know it's extraordinary, inside and out. Its built-in textured grip was sculptured to fit your hand more comfortably. And its advanced design represents an exciting new achievement in making fine cameras. Something we've been doing for over 50 years.



The XG-M accepts over 45 interchangeable, computer-designed Minolta lenses. As well as the Minolta system of SLR accessories.

The new Minolta XG-M. It's designed to have everything.

Except competition.

WAIT 'TIL YOU SEE HOW GOOD YOU CAN BE.

MINOLTA

For more information write Minolta Corporation, 101 Williams Drive, Ramsey, N.J. 07446
Or see your Minolta dealer. In Canada: Minolta, Ontario, L4W 1A4
Product appearance and/or specifications are subject to change without notice
©1981 Minolta Corporation

AND ITS COMPETITION.

More Is Not Necessarily Better

Researchers are learning that an excess of a required nutrient may present as much of a cancer risk as a deficiency

by T. Colin Campbell

The current spate of publicity concerning the possible role of diet and nutrition in certain kinds of human cancer has led to much public misunderstanding and confusion. At various times, animal fat and an excess of protein, calories, and sugar have been implicated as possible carcinogens, whereas inadequate amounts of vitamin C, vitamin E, vitamin A, zinc, and selenium (a soil mineral that is found in most vegetables and cereal grains) have been thought to enhance the risk of cancer.

There are about forty substances required by the human body to maintain health and sustain growth. Considered individually, each of these nutrients can influence the risk of cancer in only one of three possible ways: have no effect; inhibit the development of cancer; enhance the risk. Nutrients, however, are not consumed singly but in groups in which their behavior may be altered. Therefore, if there is ever to be more clarity, we must seek to understand the effects of multiple nutrient intakes and analyze dietary patterns in terms of the ways in which the simultaneous actions of nutrients can modify the risk of cancer.

In order to better appreciate these nutrient effects, a brief description of the carcinogenic process is helpful. The simplest model divides the process into three phases: initiation; cell modification; and metastasis, or invasion of other tissues.

In the initiation phase, a normal cell is converted into a neoplastic one —that is, a cell that grows without restriction—through the process of mutation. The mutation occurs when a chemical reacts with and changes the cell's genetic material, or deoxyribonucleic acid (DNA), so that subsequent generations of daughter cells derived from the parent cell are permanently altered. A wide variety of natural chemicals, such as aflatoxin (a mold product found primarily on improperly stored peanuts and corn) and a chemical found in black pepper, as well as some synthetic chemicals are capable of acting as initiators during this phase. After ingestion, most of these initiators are metabolized by an enzyme system to reactive products that bind tightly to certain sites on the DNA molecule. If not removed or neutralized, these initiators ultimately transform normal cells into neoplastic cells, which can be either benign or malignant. When that happens, the initiation phase is completed.

Some of these initiated cells then progress over a period of years through the second, or modification, phase to the ultimate cancer cell that characterizes malignant tumor tissue. This long period is considered a latent one, in large measure because cells progressing through the series of stages involved cannot be readily detected. Some compounds may positively promote the growth of these latent cells, whereas others may inhibit that growth. The human body may, in some cases, recognize these "new" cells as foreign bodies—as it does with foreign bacteria—and destroy them by means of its immunological defense system. If this happens, the carcinogenic process is intercepted and fully developed tumor cells never appear. If, on the other hand, these latent cells escape the body defenses and receive nourishment for growth, they eventually give rise to dangerous malignant cells. Whereas many factors may promote the development of these latent cells, others may repress that development. We are now beginning to understand that a wide variety of biochemical and physiological mechanisms may account for these modifier effects.

In the third phase of cell transformation—which does not always take place—the fully developed cancerous cells begin to take on properties that permit transport to, and invasion of, other tissues, a process known as metastasis. This phase has often been described in terms of histological, or tissue, characteristics, although much new information is rapidly becoming available on biochemical and/or biophysical characteristics. Our present knowledge of the effects of nutrients on this third phase is incomplete. Nutrients may or may not affect metastasis.

This three-phase concept is quite useful if we consider how dietary management might be used to repress or prevent the exceedingly complex disease of cancer. In theory, prevention ought to be achievable in either of two ways. The elimination of all dietary initiators is one hypothetical possibility. But since their total elimination is not practical, manipulation of the agents producing cell modification offers a second possibility. When consumed at inappropriate levels of intake, most nutrients tested may act as cell modifiers. In addition to the presence of essential nutrients in foods, there may also be a wide variety of other nonnutrient chemicals such as aflatoxin. Some of these nonnutrient compounds may act as initiators, some may be virtually innocuous, and still others may act as modifiers.

With respect to nutrients, what is an inappropriate level of intake? All nutrients, of course, are required in the human diet at some minimum level in order to satisfy a wide variety of bodily functions. But we are now beginning to recognize that an excessive intake of nutrients may be harmful. When evaluating the effects of nutrients on the risk of cancer, we should attempt to identify the optimum in-

NOW YOU CAN AFFORD TO BUY THE BOOKS YOU WANT TO READ

Tired of today's bookstore prices? Consider the QPB alternative: softcover editions in hardcover sizes that are durably bound and printed on fine paper—but that cost up to 65% less than their hardcover counterparts. QPB. It's the idea whose time has come.





403. How to Doctor Your Feet Without the Doctor. Myles J. Schneider, D.P.M. and Mark D. Sussman, D.P.M. QPB: $7.95

497. The New York Times 60-Minute Gourmet. Pierre Franey Hardcover: $10.95 QPB: $5.95

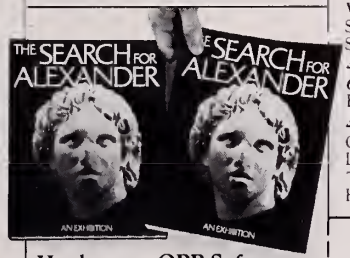
413. Selling Your Photography: The Complete Marketing, Business, and Legal Guide. Arie Kopelman and Tad Crawford Hardcover: $13.95 QPB Ed: $6.95

402. Fanny: Being the True History of the Adventures of Fanny Hackabout-Jones. Erica Jong Hardcover: $12.95 QPB: $5.50

388. The Woman Warrior and China Men. (2 Vols., Boxed) Maxine Hong Kingston Hardcover: $18.90 QPB Ed: $9.95

329. How You Can Make $20,000 a Year Writing (No matter where you live) Nancy Edmonds Hanson Hardcover: $10.95 QPB: $5.95

Compare



Hardcover: $24.95 QPB Softcover: $9.95

111. The Search for Alexander An Exhibition. Contributions by Nicholas Yalouris, Manolis Andronikos, and Katerina Rhomiopoulou. (Photographs) Hardcover: $24.95 QPB: $9.95

450. The Grand Panjandrum & 1,999 Other Rare, Useful, and Delightful Words and Expressions J.N. Hook Hardcover: $13.95 QPB Ed: $6.95

457. The Pursuit of Attention Power and Individualism in Everyday Life. Charles Derber Hardcover: $14.50 QPB: $4.95

458. The Thirties: From Notebooks and Diaries of the Period. Edmund Wilson. Edited with an Introduction by Leon Edel Hardcover: $17.95 QPB Ed: $8.95

462. Mathematical Magic Show and Mathematical Circus. (2 Vols.) Martin Gardner Hardcover: $18.90 QPB: $7.90

564. Solar Houses: 48 Energy-Saving Designs. Louis Gropp Hardcover: $15.95 QPB: $6.95

428. Time and the Riddle: Thirty-one Zen Stories. Howard Fast QPB: $5.95

619. Doonesbury Classics. (4 Vols., Boxed) Garry Trudeau. QPB: $12.95

121. Gödel, Escher, Bach: An Eternal Golden Braid. Douglas R. Hofstadter. QPB: $7.95

126. The Arbor House Treasury of Modern Science Fiction Compiled by Robert Silverberg and Martin H. Greenberg Hardcover: $19.95 QPB: $7.95

Let's try each other for 6 months.

Quality Paperback Book Club, Inc., Middletown, Pa. 17057.
Please enroll me in QPB and send the 3 choices I've listed below. Bill me $3, plus shipping and handling charges. I understand that I am not required to buy another book. You will send me *QPB Review* (if my account is in good standing) for 6 months. If I have not bought and paid for at least 1 book in every six-month period, you may cancel my membership. A shipping and handling charge is added to each shipment.

QB113-5

Indicate by number the 3 books or sets you want ☐ ☐ ☐

Name _____ 1-16
(Please print clearly)

Address _____ **Apt.** _____

City _____ **State** _____ **Zip** _____

How membership works.
1. You receive **QPB Review** 15 times each year (about every 3½ weeks). Each issue reviews a *new* **Main Selection**, plus scores of Alternates. All Main Selections with established publisher's prices are offered at *at least* 20% discount off that price.
2. If you want the **Main Selection** do nothing. It will be shipped to you automatically. If you want one or more Alternate books—or no book at all—indicate your decision on the reply form always enclosed and return it by the date specified.
3. **Bonus books for Bonus Points.** For each book or set you take (except the first 3 you get for $1 each), you earn Bonus Points which entitle you to choose any of the books we offer; you pay only shipping and handling charges.
4. **Return privilege.** If *QPB Review* is delayed and you receive the **Main Selection** without having had 10 days to notify us, you may return it for credit at our expense.
5. **Cancellations.** You may cancel membership at any time by notifying QPB. We may cancel your membership if you elect not to buy and pay for at least one book in every six-month period.

338. Photography in Focus: A Basic Text. (New Edition) Mark Jacobs and Ken Kokrda. QPB: $9.95

215. The Official Preppy Handbook Edited by Lisa Birnbach. QPB: $3.95

354. The Next Whole Earth Catalog. Edited by Stewart Brand QPB: $10.95

200. The Art of Cooking for Two Coralie Castle and Astrid Newton and **One Pot Meals.** Margaret Gin (2 Vols.) QPB: $10.90

275. The Tokyo-Montana Express Richard Brautigan Hardcover: $10.95 QPB Ed: $5.95

440. Everybody's Business: An Almanac (The Irreverent Guide to Corporate America). Edited by Milton Moskowitz, Michael Katz and Robert Levering Hardcover: $21 QPB: $7.95

Join now. Pick any 3 books or sets for $1 each—with no obligation to buy another book.

373. Dream's Edge: Science Fiction Stories About the Future of Planet Earth. Edited by Terry Carr Hardcover: $14.95 QPB: $4.95

374. Second Person Rural: More Essays of a Sometime Farmer. Noel Perrin Hardcover: $10 QPB Ed: $5.95

391. The Craft of the Potter Michael Casson. QPB: $6.95

359. The Living World of Audubon. Roland C. Clement QPB: $8.50

370. Still Life with Woodpecker and Another Roadside Attraction (2 Vols.) Tom Robbins. QPB: $11.90

475. The Zero-Sum Society Distribution and the Possibilities for Economic Change. Lester C. Thurow Hardcover: $12.95 QPB: $3.95

479. Anatomy of an Illness as Perceived by the Patient Norman Cousins Introduction by René Dubos Hardcover: $9.95 QPB: $4.95

480. The Collected Stories of Eudora Welty Hardcover: $17.50 QPB Ed: $8.95

405. Let's Go: Europe 1981-82 Harvard Student Agencies QPB: $6.95

571. The Basic Book of Photography, Revised Edition. Tom Grimm. QPB: $6.50

QPB

The first book club for smart people who aren't rich.



FREE CATALOG

Our bigger-than-ever Summer Catalog is filled with quality apparel and equipment for all your outdoor adventures. Every item in it is Unconditionally Guaranteed to please or your money back. Request your personal copy today and see why we've been the most trusted name in outdoor outfitting for more than half a century.

☐ Rush me your FREE Summer Catalog.

Name _____

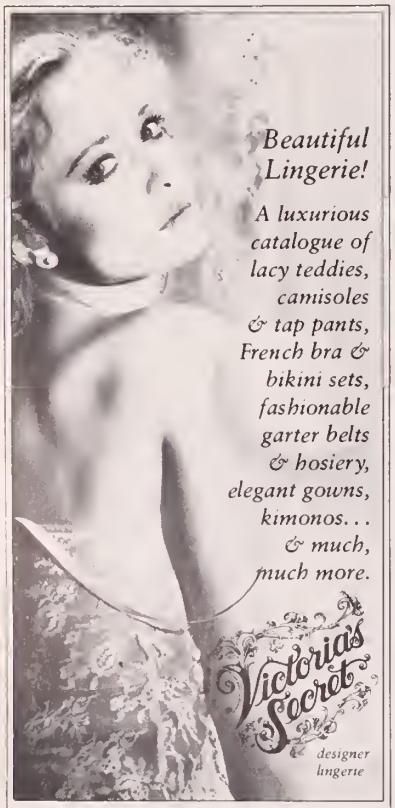
Address _____

City _____

State _____ Zip _____

Eddie Bauer®

Dept. FNH, Fifth & Union, Seattle, WA 98124



Send $3 for catalogue to Dept. NH-05 Box 31442, San Francisco, CA 94131

Boutiques: San Francisco, Palo Alto & Cupertino, CA

take—within some range—that produces the most beneficial nutritional results while minimizing the risk of cancer. One emerging concept is that those levels that optimize such traditional nutritional effects as healthy growth are the same levels that minimize cancer risk. We now know that inappropriately low intakes of some nutrients may cause an enhancement of the cancer process, whereas with other nutrients inappropriately high intakes may create the same result.

It should be possible to take in nutrients within an optimum range by selecting a wide variety of readily available foods without resort to compensatory gimmicks. This concept, although straightforward, is too often ignored. There have been claims, for example, that unusually high nutrient intakes of selenium and vitamin C are useful in reducing the risk of cancer when, in fact, the experimental observations on which the claims are based were made on much lower levels of intake. More is not necessarily better. (Incidentally, it is important to understand what constitutes an unusually high nutrient intake, or megadose. For some nutrients, including selenium, vitamin A, vitamin D, protein, and linoleic acid [a polyunsaturated fatty acid], an excessive intake may be only a few multiples of the recommended daily allowance, or RDA, established by the Food and Nutrition Board of the U.S. National Academy of Sciences. In the case of other nutrients, including some of the water-soluble vitamins such as all the B vitamins, the difference between the RDA and a potentially toxic dose may be quite large.)

Because nutrients, unlike nonnutrient chemicals, do not act as cancer initiators, we deduce that inappropriate nutrient intakes can modify the carcinogenic process without initiating it. There are numerous mechanisms that appear to account for these nutrient modifications; in fact, each nutrient affecting the carcinogenic process possesses its own set of unique characteristics. Surprisingly, this variety of mechanisms does not necessarily present a hopeless morass in terms of practical information; quite the contrary may be true. The emerging evidence suggests that a few well-chosen dietary practices may serve to simultaneously correct a variety of nutrient imbalances associated with an increased cancer risk. Before discussing such food choices, let us consider a few recently reported examples of nutrient effects that illustrate this concept.

The nutrient, other than dietary fiber, currently receiving the most attention is fat, which has been investigated both in terms of the total amount and the type of fat ingested. In the United States, about 40 to 45 percent of our total caloric intake is supplied by fat. (That compares with 10 to 15 percent for the typical Asian diet.) Several epidemiological studies suggest positive relationships between the total intake of fat and cancer of the large bowel, breast, pancreas, and prostate gland. The early literature on these relationships tended to infer that the higher the total fat intake, the higher the incidence of cancer, with the data for cancer of the large bowel and breast being more comprehensive than the data for pancreatic and prostatic cancer.

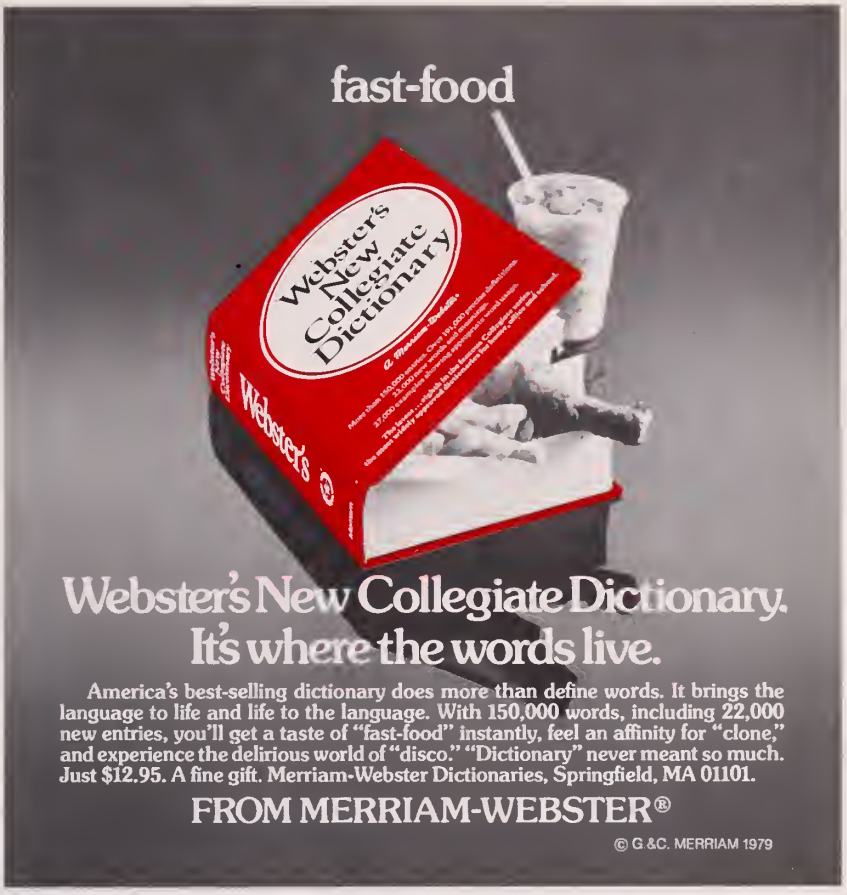
More recently, there have been several findings that may permit a finer tuning of that generalization. First, the type of fat appears to be important. Although earlier human population studies indicated a more significant carcinogenic risk with saturated fat (derived largely from animal sources) than for unsaturated fat (from plant sources), later animal model studies did not support this contention. There is now increasing evidence for enhancement of the carcinogenic process by the ingestion of linoleic acid, the only fatty acid that is essential in the human diet. Linoleic acid is present in large amounts in vegetable oils, such as corn oil and safflower oil, where it makes up one-half to three-fourths of the total fatty acids. In addition, animal studies suggest that increasing the intake of linoleic acid increases tumor yield only when there is already a sufficiently high level of total fat. In rats, as with human infants, the requirement for linoleic acid appears to be easily met when that chemical makes up about 0.5 to 1.0 percent of the diet. In the rat studies, where an experimental carcinogenic initiator was given, a diet containing 2.5 percent linoleic acid increased mammary tumor yield only when the total fat content was also high, for example, when fat content represented 12 to 15 percent of the diet by weight, or 25 to 30 percent of the total calories. These effects of linoleic acid and total fat are primarily exerted during the second, or modification, phase of carcinogenesis; that

is, fat promotes the growth and development of already existing cancer cells but does not seem to initiate their formation. Human studies also seem to indicate that a diet high in polyunsaturated fats may present a risk of cancer of the breast and colon.

This emerging understanding of dietary fat illustrates the general concept that although a minimum level of a nutrient is required for good health, an excess may increase the risk of cancer. Another observation made in the above rat studies was that the relationship between linoleic acid and total fat to their carcinogenic effects is not linear as in the generally accepted model for chemical carcinogenic initiators. In short, although increasing fat twofold, fourfold, or eightfold does increase tumors, it doesn't increase them by twofold, fourfold, or eightfold. According to our present knowledge, the relationship differs for each nutrient.

The important message here is that a tumorigenic response is not necessarily exactly proportional to the level of nutrient intake. Also, estimations of cancer risks involving nutrient promoters such as linoleic acid differ from those involving carcinogenic initiators. These initiators do behave in a linear manner, that is, there is a close mathematical relationship between dosage and tumor production. A predictable number of cancer cases in a large population is a hypothetical possibility at low initiator intake levels, thus forcing the need for rigorous and perhaps absolute regulation. In the case of nutrients, not only is absolute regulation impractical but there may be good evidence that carcinogenic risk is near a minimum when the nutrients are consumed within their optimum range of intake.

Other recent data concerning the possible relationship between nutrients and cancer deal with protein, selenium, and vitamin C. To begin with, the effect of protein intake on the carcinogenicity of aflatoxin, which is not a nutrient, illustrates the same concept as that just discussed for linoleic acid. In many species, aflatoxin is a potent initiator of liver cancer, but its total elimination from the human food supply would be impossible without actually banning peanuts, corn, and the wide variety of products derived from them. (Fortunately, there has been excellent progress in this country in lowering the levels of aflatoxin sufficiently to make the sub-



Small Ad for a Big Tour of the Orient



Japan Air Lines has 35 very special tours to the Orient. Come, let us take you to the Orient of your dreams. Here is but one example: Mandarin Orient, 19–24 days, $3197–3675. All tours visit Hong Kong, Peking, Shanghai and Canton. Some tours also visit Tokyo, Penang, Singapore, Bangkok as well as certain cities in China. All tours fully escorted and most meals are included.

Rates based on double occupancy and economy air fare from the West Coast and are subject to change. Additional charge for June–October peak season.

CALL TOLL FREE
800-835-2246,* Ext. 143
for free tour information, see your travel agent, or mail this coupon today.
Japan Air Lines, P.O. Box 10618
Long Island City, New York 11101

JAL HAPPY HOLIDAYS
JAPAN AIR LINES

Dear JAL: I've read your small ad and I'd like more details of the tours I've checked.
☐ Mandarin Orient (3005)
☐ Other Happy Holidays Tours

Name_____
Address_____
City_____ State_____ Zip_____
Travel Agent_____ NH 0581
*Continental U.S. only. In Kansas: 800-362-2421

stance of negligible harm.) In rat studies, the carcinogenicity of aflatoxin is decreased when the intake of protein is also decreased. The least carcinogenic effect of aflatoxin appears to occur when protein levels are at or slightly below the recommended dietary allowance. As the level of dietary protein is increased above its requirement, aflatoxin carcinogenicity is also increased, although beyond a certain level of dietary protein (about 20 percent of total diet by weight) there appears to be no further increase. Similar data have also been published in other studies concerning other carcinogens. Once again, the carcinogenic response is most prominent at higher levels of protein intake, with the minimum effect occurring at protein levels near the requirement. In other words, there must be an adequate intake to meet the many needs of the body but not an excessive intake that may increase the risk of cancer. Incidentally, several human epidemiological studies show an extremely impressive positive correlation between dietary protein intake and cancer of the breast, colon, prostate, and pancreas.

Vitamin C (ascorbic acid) is a unique nutrient in that it is required only by primates (including humans), the guinea pig, and a few other, lesser-known species. The daily intake of ascorbic acid recommended for humans is 60 milligrams (recently increased from an RDA of 45 milligrams). The arguments advanced by Linus Pauling that vitamin C prevents the common cold and, perhaps, cancer specify enormous intakes of 10,000 milligrams per day or more. Since it is almost impossible to get more than 1,000 to 1,500 milligrams per day with traditional foods—even those high in ascorbic acid—such megadose effects, if they exist, would have to be regarded as pharmacological rather than nutritional. There is evidence in laboratory studies on rats that vitamin C inhibits gastric and intestinal cancer caused by nitrosamines (compounds derived from the nitrites and nitrates that are added to, as well as found naturally in, certain foods). But adequate protection should be afforded by restricting intake to modest—not megadose—levels. In fact, at very high, or megadose, levels, there is an indication that vitamin C can be mutagenic, which might even suggest a carcinogenic response.

Another nutrient for which inappropriately low or high levels of intake may increase the risk of cancer is selenium. Although the data on this substance need considerably more confirmation, the existing data indicate, once again, that whereas an adequate nutritional intake minimizes cancer risk, more is not necessarily better.

What then is the most appropriate dietary pattern that might allow for simultaneous nutritional benefits? The above-mentioned examples indicate that a diet lower than the current American one in total fat, linoleic acid, and protein, but higher in vitamin C, fiber, and selenium would hypothetically yield the lowest cancer risk. Such a dietary balance can be achieved by an increase in the consumption of whole grain cereal products, vegetables, and fruits, and a reduction in meats and foods prepared in fat. With that regimen, dietary fiber and vitamin C would be increased, while protein and total fat would be decreased. In addition, if less oil were used in cooking, linoleic acid consumption would also be decreased. Selenium intake, however, would not necessarily be altered by such a dietary change. The amount of selenium in a diet is determined primarily by the geographical area from which the food in the diet comes because the amount of selenium available in a particular soil apears to establish the selenium content in the food it yields. Moreover, individual nutrients such as vitamin C, vitamin A, vitamin E, certain amino acids, and polyunsaturated fatty acids may affect the uptake of selenium from the intestinal tract into the bloodstream.

In summary, although it may not be possible to establish the specific effect of the intake of every individual nutrient on the cancer process, the reorientation of diet suggested here should bring about the desired simultaneous alteration of nutrients. Moreover, such a dietary pattern coincides with that recommended for the prevention of cardiovascular disease. Indeed, the same goals should be attained by following the dietary guidelines recently established in the United States by the Department of Agriculture and the Department of Health and Human Services.

T. Colin Campbell is professor of nutritional biochemistry in the Division of Nutritional Sciences at Cornell University in Ithaca, New York, and director of the division's nutrition and cancer program.

Full-Line Leica dealers:

ARIZONA—Phoenix: Foto Forum, Guild Camera

CALIFORNIA (Northern)—Berkeley: Berkeley Commercial Photo **Larkspur Landing:** The Camera Company **Monterey:** Ken s Cameras **Palo Alto:** Keeble & Shuchat **San Francisco:** Adolph Gasser, Brooks Cameras, The Darkroom, Pacific Camera **San Mateo:** Brooks Cameras **Santa Cruz:** Camera Connection **Stockton:** Gluskin s Camera Corner **Walnut Creek:** Photo Center

CALIFORNIA (Southern)—Beverly Hills: Beverly Hills Camera **Costa Mesa:** Cal s Cameras **Goleta:** Tony Rose Camera **Hollywood:** Bob Gamble s Photo **Los Angeles:** Bel Air Camera, Frank s Highland Park Camera, Kimura Photomart, Olympic Camera **Pasadena:** Alvin s Photo, Lee-Mac Camera Exchange **Redondo Beach:** Riviera Camera Shop

COLORADO—Aspen: Walnut House **Denver:** Gart Bros Sporting Goods, Waxman Camera, Werner s Mile High Camera **Grand Junction:** Monument Photographic Corp

CONNECTICUT—Hamden: Karber Photo **Hartford:** Camera Bar **New Haven:** Fair Haven/Fairgraphics

DELAWARE—Wilmington: Lincoln Camera

DISTRICT OF COLUMBIA—Washington: Penn Camera Exchange, Pro Photo

FLORIDA—Casselberry: International Camera **Coral Gables:** Mileo Photo Supply **Fort Lauderdale:** Clik Camera Shop **Lake Worth:** Quality Photo Service **Miami:** Benson s Camera, Bristol's, Downtown Camera, Miami Camera Center, Pitman Photo **Palm Beach:** Ramon's Camera Shop **St. Petersburg:** Abner s Camera Exchange **Tampa:** Southern Photo & News

GEORGIA—Atlanta: Crown Camera Exchange, Wallis Kamera Haus

HAWAII—Honolulu: Francis Camera Shop

IDAHO—Boise: Idaho Camera

ILLINOIS—Chicago: Camera Exchange, Central Camera, Helix Ltd, Herman Cameras, Shutan Camera **Evanston:** Poe s Camera **Orland Park:** Camera Cove **Peoria:** Peoria Camera

INDIANA—Muncie: Jack s Camera **South Bend:** Schilling s

IOWA—Iowa City: Henry Louis

KANSAS—Kansas City: Western Photo-Graphic **Topeka:** Wolfe s Camera Shop **Wichita:** Lawrence Photo

LOUISIANA—New Orleans: Alfredo s Cameras **Shreveport:** Par Excellence

MARYLAND—Rockville: Bunton Instrument **Silver Spring:** Industrial Photo **Wheaton:** Gilbert s

MASSACHUSETTS—Arlington: New England Photo **Boston:** Claus Gelotte, E. Philip Levine **Cambridge:** Claus Gelotte **Chicopee:** Piepul's Camera **Malden:** Hunt Drug

MICHIGAN—Ann Arbor: Home Appliance Mart **Birmingham:** Birmingham Camera World Camera **Dearborn:** Adray Appliance **Muskegon:** Al Chnstopher s Camera **Royal Oak:** Century Camera

MINNESOTA—Golden Valley: National Camera **Minneapolis:** Photo Visuals

MISSOURI—Kansas City: Crick's Camera **St. Louis:** Creve Coeur Camera, St. Louis Photo **Springfield:** Ozark Camera

NEBRASKA—Omaha: Dean s Camera

NEW HAMPSHIRE—Hanover: Camera Shop of Hanover **Manchester:** The Camera Shop

NEW JERSEY—Bricktown: The Photo Center **Northfield:** Corral Camera Lounge **Parsippany:** Sight and Sound **Upper Montclair:** Photo Cullen

NEW YORK—Albany: State Photo Supply **Amityville:** Berger Bros. Camera **Bronx:** Arista Camera Specialists **Brooklyn:** Focus Electronics **Buffalo:** Delaware Camera Mart, **Great Neck:** Ken-Mar Camera **New York City:** Alkit Camera Shoppe, Cambridge Camera Exchange, Camera Barn, Competitive Camera, Dumont Camera, Executive Photo & Supply, 47th Street Photo, Jaydee Camera Exchange, Ken Hansen Photo, Olden Camera & Lens, Wall Street Camera Exchange, Willoughby s **Newburgh:** Seaman's **Rochester:** Photogenesis Camera Center **Schenectady:** Reales **Syracuse:** M O Camera Center **Yonkers:** Sam s Camera Exchange

NORTH CAROLINA—Greensboro: Camera World **Raleigh:** Sam Bass Camera Shop

OHIO—Akron: Metzger Photo Supply **Bedford Heights:** Laurel Camera **Cincinnati:** Growth Systems, Provident Camera **Cleveland:** The Dodd Company **Dayton:** Malone Camera **Worthington:** Don McAlister Camera

OKLAHOMA—Oklahoma City: Pipkin Photo Supply **Tulsa:** Camera Gallery, Engler Photo Supply

OREGON—Beaverton: Suburban Photo **Corvallis:** Oregon State University Book Store **Portland:** Citizens Photo, Conkling, Inc

PENNSYLVANIA—Allentown: Classic Photo Lab **Ephrata:** Lee s Camera Center **Philadelphia:** Kosmin s Camera Exchange, Photo-Cine Shop, **Pittsburgh:** Kadet Photo **Reading:** Alton E Bower's Photo

RHODE ISLAND—Providence: Adler s

TENNESSEE—Memphis: Memphis Photo Supply **Nashville:** McGinnis, Inc.: Photographic Systems

TEXAS—Austin: Capitol Camera, **Dallas:** Cooter s Village Camera **Fort Worth:** Seymour s Photo Supply **Houston:** George Lange/Cameras, Southwestern Camera **New Braunfels:** Seidel Camera Shop **Tomball:** Custom Camera

VERMONT—Burlington: Photogarden

VIRGINIA—Charlottesville: Cary s Camera Shop **Fairfax:** Fuller and D'Albert **Williamsburg:** Massey s Camera Shop

WASHINGTON—Seattle: Clyed's Camera Stores, Olympic Camera Center, University Book Store **Spokane:** Huppins Hi Fi & Photo

WISCONSIN—Appleton: Ideal Photo **Milwaukee:** Casanova's, Reimer s Photo Materials **Racine:** Camera World

Or write for more information.
E. Leitz, Inc., Rockleigh, N.J. 07647.

You wouldn't hang a Picasso in the closet. You'd show it in its best light. Proudly. Leica feels the same way about photography. It would be a pity if pictures taken with our amazing R4 weren't projected with our equally amazing Pradolux* RT300. Each is superb. Together, incomparable.



Consider the Leica* R4, the camera that's so automatic, so responsive, it can do everything, simply. It's the only camera in the world with two independent light meter systems. You can select either full-area (averaging) or selective (spot) metering with a touch of the controls. And you have multi-mode exposure automation working with the two metering systems. Again truly unique. This gives you shutter priority, aperture priority, programmed control, metered manual and flash automation in fractions of a second. And you have a full system of accessories including motor drives and the incomparable Leica-R lenses to bring all this potential to actuality, simply.





The only slide projector made to this high standard is our own: the Pradolux RT300. It offers Leica lenses in a full range from 60 to 200mm in both curved and flat-field configurations. The internal condensers are just as important as the lenses. That's why ours are Leica optical quality, too. You can count on high efficiency cooling for long life of the projector, the lamp and your slides. The Pradolux RT300 accepts Kodak Carousel* trays and stack loaders. Plus a range of built-in features that seems to go on forever.

*Trademark Eastman Kodak Company.

In fact, with both the Leica R4 camera and Pradolux RT300 slide projector you will see how impressive your images really are, Pablo. Ask your full-line Leica dealer for information; he's listed in the adjacent column.

Leitz

Leitz means precison. Worldwide.



THE LUXURY SEDAN THAT DID NOT HAVE TO BE RE-ENGINEERED TO FACE DIFFICULT TIMES.



Will the trials and tribulations of the automobile industry never end?

First came the Environmental Protection Agency and the need to re-engineer to meet the emission requirements.

Then came the gas crises and the need to re-engineer to meet the demands of the gas pump.

Then came last year's money crunch and the most serious challenge of all: the enlightened consumer.

And, with a certain predictability, the luxury sedan makers of the world reacted by bringing forth a slew of "revolutionary" new automobiles, each radically re-engineered to answer the perfectly reasonable question, "What is it that makes an expensive car worth the money?"

A question perhaps uniquely answered by the BMW 528i.

TECHNOLOGY DECADES AHEAD OF THE COMPETITION.

As some of the world's most exalted automobile manufacturers rush to update anachronistic technology—cutting cylinders, resorting to diesel fuel, tinkering with all manner of electronic gadgetry—one caveat should be observed: evolution, as any automotive expert will testify, is always far preferable to revolution. We are, after all, dealing with a machine made up of several thousand parts.

Which is perhaps the most convincing argument for owning the BMW 528i. A car developed and refined over two decades. An engineering concept so basically sound that an era of automotive restrictions has, if anything, proven it to be even more correct.

A SYNERGISTIC USE OF ELECTRONICS AND MECHANICS.

Car and Driver magazine has seen fit to predict, "In the not-too-distant future, most cars will be equipped with some form of electronic fuel injection simply because it is a more precise fuel-delivery system."

Far from just beginning to dabble in the sophisticated arena of electronics, BMW installed such a system in 1975.

With every engine revolution a computer receives and assesses signals from electronic sensors within the 6-cylinder engine itself. Then instantly determines the precise air/fuel mixture to be injected into the cylinder ports—optimizing emissions, fuel consumption and power development to a degree once considered merely within the realm of academic theory*

So flawless is this marriage of electronics and mechanics that it has resulted in a virtual automotive paradox: an engine which not only performs with more fuel efficiency but with more power as well.

THE DRIVER COMPLETES THE MECHANICAL CIRCUIT.

The interior of the 528i, while classically restrained in style, denies its occupants nothing with regard to appointments or accessories.

But, perhaps because of our involvement with motor racing, we take a wholly different approach to the interior of an automobile.

An approach which includes the driver as a functioning part of the car.

A standard 5-speed transmission (automatic is available) affords the unaccountably unique opportunity to pick and choose one's own gears.

An advanced suspension system—independent on all four wheels—provides what one automotive journalist hailed as "a confidence-inspiring stability." Giving the driver an uncanny feel for the road.

EXTRAORDINARY ENGINEERING IS AN EXTRAORDINARY INVESTMENT.

BMW has always contended that only one thing makes an expensive car worth the money: Extraordinary engineering.

The BMW 528i has itself turned that contention into fact.

For, according to the Oct. 1980 NADA Used-Car Guide, over the past 5 years, the 5 Series has retained an astonishing 77.9% of its original price.

A figure which neither the Mercedes 280E, nor the Jaguar XJ6, nor Cadillac can approach.

If you find the notion of owning a BMW intriguing, phone your nearest BMW dealer and arrange a thorough test drive.

THE ULTIMATE DRIVING MACHINE.

BMW. MUNICH GERMANY

*For example, the BMW 528i (with 5-speed standard transmission) delivers 18 EPA estimated mpg, 30 estimated highway mileage and, based on these figures, an estimated mpg range of 295 mi. and a highway range of 492 mi. (Naturally, our fuel efficiency figures are for comparison purposes only. Your actual mpg and range may vary, depending on speed, weather and trip length. Your actual highway mileage and highway range will most likely be lower.) © 1981 BMW of North America, Inc. The BMW trademark and logo are registered trademarks of Bayerische Motoren Werke A.G.

The Titular Bishop of Titiopolis

The posing of a problem in a novel way is a virtual prerequisite of great science

by Stephen Jay Gould

Modern geology began, or so the usual story goes, with the publication of a book so oddly named that it almost surpasses the peculiarity of the title later assumed by its author, Nicolaus Steno, a Dane by birth and a Catholic convert who became Titular Bishop of Titiopolis (*in partibus infidelium*) in 1677. (Titular bishops "preside" over areas in pagan hands and therefore unavailable for actual residence—in the realm of infidels, as the Latin subtitle proclaims. The old bishopric of Titiopolis is now part of Turkey.) As his real job, dangerous enough in Protestant lands, Steno ministered to the scattered Catholic remnants of northern Germany, Norway, and Denmark.

The book, published in 1669, bears a title considered "almost unintelligible" by its chief translator from the original Latin. It is called *De solido intra solidum naturaliter contento dissertationis prodromus,* or *Prodromus to a dissertation on a solid body naturally contained within a solid.* A prodromus is an introductory discourse, but Steno never wrote the promised dissertation because his religious interests, following his conversion in 1667 and his ordination in 1675, led him to abandon his distinguished scientific career as a medical anatomist and, by fortuitous introduction at the very end of his scientific work, a geologist.

Why a solid within a solid? And what can such a cryptic phrase have to do with the origin of modern geology? Posing a problem in a startling and novel way is the virtual prerequisite of great science. Steno's genius lay in recognizing that a solution to the general problem of how solid bodies get inside other solids might provide a criterion for unraveling the earth's structure and history. But Steno did not formulate his problem by rational deduction from his armchair. As so often happens in a human world, he drifted toward it after an accidental beginning.

Like many anatomists, Steno became interested in the resemblances of humans to other animals. He decided to dissect sharks and made some important discoveries. He demonstrated, for example, that the tight coils of the spiral intestine yielded the same total length (within a more confined space) as the meandering intestine of mammals. In October 1666, during Newton's great year, or *annus mirabilis,* and a month after London burned, Steno received for study the head of a giant shark caught at the city whose English name Leghorn is as peculiar as Steno's two titles. (The name refers neither to limbs nor musical instruments, but represents a poor English rendering of the old spelling, Ligorno, for the town now called Livorno in Italian.) Steno, like so many intellectuals, was working at the nearby city of Florence under the patronage of Ferdinand II, the Medici grand duke. In examining the teeth of his quarry, Steno recognized that he had accidentally bought into one of the major scientific debates of his age, the origin of *glossipetrae,* or tongue stones.

These fossil sharks' teeth could be collected by the barrel, especially in Malta. In twentieth-century terms, their origin cannot be doubted. They are identical to the teeth of modern sharks in outward form and detailed structure and chemical composition—therefore they cannot be anything but sharks' teeth. (Even our antediluvian creationists today do not deny it.)

Yet the identity in form that makes us so certain led to another potential interpretation in Steno's time—for God, the author of all things, often created with striking similarity in different realms to display the order of his thoughts and the glorious harmony of his world. If he had made a world with seven planets (sun, moon, and the five visible planets of an older cosmology) and seven notes in a musical scale, why not imbue rocks with the plastic power to form objects precisely like the parts of animals? After all, the *glossipetrae* came from rocks and rocks were created as we find them. If the tongue stones are sharks' teeth, how did they get *inside* rocks? Moreover, the earth is only a few thousand years old, and tongue stones inundated European collections. How many sharks could have infested Mediterranean waters in so short a time?

Steno observed that his shark had hundreds of teeth and that new ones formed continually as old teeth wore



Take the $81.80 Library of Ancient Civilizations for only $2.97

when you join the **Natural Science Book Club.** You simply agree to buy 3 more books—at handsome discounts—within the next 12 months.

Here's a fantastic opportunity to get this beautiful $81.80 set of 4 oversized volumes for only $2.97. Together they present a fascinating view of the development of mankind.

THE ARCHAEOLOGY OF GREECE. William R. Biers. A splendidly illustrated volume presents a historical and artistic summary of ancient Greek culture. Traces the stylistic developments in architecture, sculpture, painting and other art forms. With 106 drawings, 334 photographs, 8 pages of color plates. Publisher's Price $29.95

ANCIENT EGYPT, THREE THOUSAND YEARS OF SPLENDOR. Warner Hutchinson. Provides a fascinating tour of the Nile, Egyptian life styles, and the reasons why Egypt rose to such heights in the ancient world. Contains over 125 photographs of wall paintings, architecture and statuettes. Publisher's Price $16.95

STONEHENGE AND ITS MYSTERIES. Michael Balfour. 200 diagrams, maps, charts and striking photographs combined with authoritative text reveal both the facts and mysteries of Stonehenge. Shows how artists, politicians, astronomers and the public have viewed Stonehenge through the ages. Also discusses other nearby prehistoric sites. Publisher's Price $14.95

THE MAYA. 2nd Edition. Michael Coe. Newly revised classic presents every stage of the 3000-year rise and fall of the New World's most advanced civilization. Explores in detail the Mayan life cycle, their stunning art, inscrutable hieroglyphs, the building of palaces, temples and pyramids, the intricate Mayan calendar and much more. With 141 illustrations. Publisher's Price $19.95

What is the Natural Science Book Club? A unique book club devoted to bringing you exciting, refreshingly different books on all areas of the natural sciences. From the life story of early man to the death of the solar system... from the largest mammals to the invisible kingdom of microscopic organisms... all the wonders of the natural world are revealed to members of the Natural Science Book Club.

MEMBERSHIP BENEFITS • In addition to getting the Library of Ancient Civilizations for only $2.97 when you join, you keep saving substantially on the books you buy. • Also, you will immediately become eligible to participate in our Bonus Book Plan, with savings of at least 70% off the publisher's prices. • At 3–4 week intervals (16 times per year) you will receive the Book Club News, describing the coming Main Selection and Alternate Selections, together with a dated reply card. • If you want the Main Selection, do nothing and it will be sent to you automatically. • If you prefer another selection, or no book at all, simply indicate your choice on the card, and return it by the date specified. • You will have at least 10 days to decide. If, because of late mail delivery of the News, you should receive a book you do not want, we guarantee return postage.

Natural Science Book Club
Riverside, New Jersey 08075 4-AL7

Please accept my application for trial membership and send me the Library of Ancient Civilizations A(10106), billing me only $2.97. I agree to purchase at least three additional Selections or Alternates over the next 12 months. Savings range up to 30% and occasionally even more. My membership is cancelable any time after I buy these three books. A shipping and handling charge is added to all shipments.

No-Risk Guarantee: If you are not satisfied—for any reason—you may return your introductory books within 10 days and your membership will be canceled and you will owe nothing.

Name_____

Address _____

City_____

State_____ Zip_____

(Offer good in Continental U.S. and Canada only. Prices slightly higher in Canada.)

L.L.Bean®
Outdoor Sporting Specialties

Durable Chino Comfort

$14.00



You'll get more wearing pleasure from these pants than any others you own. Made of high grade combed cotton/polyester twill. Permanent crease, washable No ironing required. Neat looking for sports or work Color, Light Tan. Men's waist sizes: 24, 25, 26, 27, 28, 29. Inseams 30" and 32". Even waist sizes 30 to 44 plus 31 and 33. Inseams 29", 30", 31", 32", 33" and 34"

Please Ship Postpaid
____#1822W Wm's and Mn's Chinos @ $14.00
Size_____ Inseam_____
☐ Check Enclosed ☐ Master Card
☐ VISA ☐ American Express

Card Number _____
☐ SEND FREE CATALOG Exp. Date
Name_____
Address _____
City_____
State_____ Zip_____

L. L. Bean, Inc.
726 Casco St., Freeport, ME 04033

OCEAN SEARCH

in Canada's Fundy Isles

Nature expeditions in search of whales, porpoise, seals and pelagic birds. The package includes transportation from Saint John, New Brunswick, accommodation, meals, films and lectures.

For information write

MARATHON INN

Grand Manan Island
New Brunswick, Canada
or contact your
Air Canada or
Via Rail agent

down and fell out. The numbers of *glossipetrae* from Malta no longer foreclosed an origin in sharks' mouths, even under the Mosaic chronology (which Steno did not question). According to the common legend that great scientists are unprejudiced observers who can shuck constraints of culture and see nature directly, Steno came to his correct conclusion—that *glossipetrae* are fossil sharks' teeth—because he made better observations. Steno was a fine observer, but he was also an adherent to the new mechanical philosophy that insisted on physical causes for phenomena and viewed detailed internal similarity as a sure sign of common manufacture in the mechanical sense. Steno did not see better; rather, he possessed the conceptual tools to interpret his excellent observations in a necessary way that we continue to regard as true.

But Steno then abstracted the problem of *glossipetrae* in a remarkably original manner—and established with this great insight his legitimate role as the founder of modern geology. The tongue stones found within rocks, Steno reasoned, were problematic because they were solids enclosed within a solid body. How did they get in there? Steno then recognized that all the troubling objects of geology were solids within solids—fossils in strata, crystals in rocks, even strata themselves in basins of deposition. A general theory for the origin of solids within solids could provide a guide for understanding the earth's history.

Taxonomy is often regarded as the dullest of subjects, fit only for mindless ordering and sometimes denigrated within science as mere "stamp collecting" (a designation that this former philatelist deeply resents). If systems of classification were neutral hatracks for hanging the facts of the world, this disdain might be justified. But classifications both reflect and direct our thinking. The way we order represents the way we think. Historical changes in classification are the fossilized indicators of conceptual revolutions.

The French scholar Michel Foucault uses this principle as his key for understanding the history of thought. In *Madness and Civilization*, for example, he notes that a new method of dealing with the insane arose in the mid-seventeenth century and spread rapidly throughout Europe. Previously, madmen had been exiled or tolerated and allowed to wander about. In the mid-seventeenth century, they were confined in institutions along with the indigent and unemployed, a motley assemblage by modern standards. We might regard this classification as senseless or cruel, but as Foucault argues, such a judgment will not help us to understand the seventeenth century.

Why classify together the poor, the unemployed, and the insane; what common theme could inspire such an ordering? Foucault argues that the birth of modern commercial society led to a new designation of the cardinal sin, the one that had to be made invisible by confining all those who, for whatever reason, wallowed in it. That sin was idleness, and Foucault shows that sloth replaced the old medieval curse of pride as the most fundamental of the seven deadly sins in seventeenth-century texts. It mattered little that the insane did not work for biological or psychological reasons, and the unemployed for want of opportunity.

Steno also reordered the world in a way that must have seemed as curious to his contemporaries as the amalgamation of madness and poverty seems to us. As his contemporaries gathered the idle, Steno identified solids within solids as a fundamental class of objects, divided them from everything else, and developed a set of criteria to sort his solids into subdivisions representing the different causes that fashioned them. The great *Prodromus* is, fundamentally, a treatise on a new system of classification for solids within solids—a classification by common genesis, rather than superficial similarity of outward appearance. Steno's revolution in thought arises from his altered classification—and his curious title, so understood, could not be more devastatingly appropriate. I have read the *Prodromus* many times, but when I finally understood its message, just last month, that bizarre title sent a shiver up my spine.

The *Prodromus* has usually been misinterpreted by geologists who attribute Steno's success to his use of modern observational methods. (In fact, although the *Prodromus* is sprinkled with astute observations, its longest section is a speculative discussion on the origin of solid bodies, based on the incorrect premise that all solids must be generated from liquids, and that the form of a solid indicates the motions of the liquids that produced it.) His translator writes, for example:

"At a time when fantastic metaphysics were rife, Steno trusted only to induction based upon experiment and observation." But the *Prodromus* reports no real experiments and only a modest number of observations. It succeeded primarily because Steno followed a metaphysic congenial with our own, but relatively new in his time.

Geologists have also judged Steno inappropriately by searching the text for gems of "modern" insight, rather than by understanding its argument as a totality. Thus, the commonest statement about the *Prodromus,* often the only statement made by geologists, holds that Steno presented the crystallographic law of the constancy of interfacial angles—that however much the size and shape of crystal faces vary, the angles between them remain the same. Well, perhaps he did, but the "law" appears as two throwaway lines in a figure caption, and has little relation to Steno's major theme or argument. (It arises simply as a corollary to his speculations about inferring the motion of fluids from the form of solids precipitated from them.)

No, the *Prodromus* is, as its title states, about solids in solids and their proper classification by mode of origin. It is founded upon two great taxonomic insights: first, the basic recognition of solids within solids as a coherent category for study and, second, the establishment of subdivisions to arrange solids within solids according to the causes that fashioned them.

Steno uses two criteria for his subdivisions. (They are blessedly obvious once you state the problem, but Steno's revolution is the statement itself.) First, in what might be called the principle of molding, Steno argues that when one solid lies within another, we can tell which hardened first by noting the impress of one object upon the other. Thus, fossil shells were solid before the strata that entomb them because shells press their form into surrounding sediments just as we make footprints in wet sand. But surrounding rocks were solid before the calcite veins that run through them because the calcite fills preexisting channelways just as jello matches the flutes of a mold. The principle of molding allows us to establish the temporal order of formation for two objects in contact. In a world still regarded by many of Steno's contemporaries as formed all at once by divine fiat, this criterion of history struck a jarring

Get the Lion's share!

High yields. Plus

Daily dividends!
Daily compounding!
Daily liquidity!

You get all this when you invest in Dreyfus Liquid Assets, the high yielding money market fund:

Dividends are declared and compounded daily. You get free checks for cash as you need it, or to pay larger bills. And you keep on earning today's high money market yields until your redemption check clears.

There is no sales charge, there's no penalty for early withdrawals--you can even redeem your investment by phone. Start with just $2,500. Additions can be as low as $100.

Learn how you can get the Lion's share of today's money market rates. Send coupon or call today.



Dreyfus Liquid Assets--

For more complete information, including management fee charges and expenses, obtain a prospectus by sending this coupon. Read it carefully before you invest or send money.

Name _____

Address _____

City _____

State _____ Zip _____

2260108

Post Office Box 600
Middlesex, NJ 08846

FOR A PROSPECTUS

Call toll free, day or night, 7 days a week

1-800-345-8501
Extension 446

In Pennsylvania
1-800-662-5180
Extension 446

0451

chord and eventually forced a transposition in thought.

Early in the *Prodromus*, Steno stated the problem that he wished to solve with his second criterion: "Given a substance possessed of a certain figure, and produced according to the laws of nature, to find in the substance itself evidences disclosing the place and manner of its production." His solution, the basic principle for any historical reconstruction, holds:

> If a solid substance is in every way like another solid substance, not only as regards the conditions of surface, but also as regards the inner arrangement of parts and particles, it will also be like it as regards the manner and place of production.

Past processes cannot be observed in principle; only their results remain. If we wish to infer the processes that formed any geological object, we must find clues in the object itself. The surest clue is detailed similarity—part by internal part—with modern objects formed by processes we can observe directly. Similarity can be misleading—and great mistakes have been made in applying Steno's principle—but our confidence in common origin mounts as we catalog more and more detailed similarities involving internal structure and chemical composition as well as external form.

Thus, Steno argues, sedimentary rocks must be the deposits of rivers, lakes, and oceans because they "agree with those strata which turbid water deposits." Fossil shells once belonged to animals, and crystals precipitated from fluids as we make salt or rock candy today.

With these two principles—molding and sufficient similarity—Steno established both prerequisites for geological, or any historical, reconstruction: he could determine how and where objects formed, and he could order events in time. Steno's genius, to say it one more time, lay in establishing this new conceptual framework for observation, not in the acuity of the subsequent observations themselves. Steno's break with older traditions stands out most clearly in his complete failure, save in one sheepish passage, to consider the primary subject that obsessed his colleagues: the identification of goals and purposes for all things, including what we now regard as purely physical processes of uplift, erosion, and crystallization. In one fleeting passage, Steno cites dissimilarity of function as a reason subservient to his usual argument about internal resemblance for stating that rocks and bones form differently. But he quickly adds the disclaimer, "if one may be permitted to affirm aught about a subject otherwise so little known as are the functions of things." As Foucault also argues, the subjects you leave out of your taxonomies are as significant as the ones you put in.

The four-part organization of the *Prodromus* has generally been viewed as disjointed or even incoherent—thrown together by a man itching to leave Florence but forced to justify the grand duke's patronage. I view it instead as a comprehensive and tightly reasoned brief for a science of geology based upon the two principles of molding and sufficient similarity.

Part one is a teaser, a specific example to demonstrate the power of the general method. The *glossipetrae*, Steno argues, must be sharks' teeth because they are identical in form and internal arrangement with the objects he had plucked from the mouth of his quarry from Leghorn. They solidified before the rocks that enclose them because they impress their form upon the surrounding sediment. Therefore—and now the argument begins to move toward revolutionary generality—sedimentary rocks were not created with the earth, but have formed as the deposits of turbid waters in rivers, lakes, or oceans. Moreover, similar marine fossils are often found high in mountains and far from the sea; these fossils also solidified before the strata enclosing them. Thus, the earth has an extensive history: seas and lands have changed places, and mountains have emerged from the waters.

In the second part, Steno argues that *glossipetrae* are but one example of the general problem of solids within solids, and that the principles of molding and sufficient similarity can establish proper taxonomic subdivisions based on common modes of origin. The third part treats the major classes of solids within solids and establishes two basic categories for objects within rocks: fossils that harden *before* the enclosing strata, and crystals and veins that form *within* solid rocks.

The fourth part, a reconstruction of the geological history of Tuscany, has been problematic or even embarrassing to geologists who wish to view Steno as their founding saint. (The Catholic Church, by the way, is also considering Steno for sainthood, and he may eventually attain an unprecedented double distinction.) Steno constructs his history to match biblical chronology, with two cycles of deposition—from the original void and from Noah's universal ocean. The essence of this part, however, is not his continued loyalty to Moses—Steno was, after all, not a man of our century—but rather his demonstration that the principles of molding and sufficient similarity can be used not only to classify objects (part three), but also to reconstruct the history of the earth from these objects (part four). The last part of the *Prodromus* demonstrates by specific example, drawn from the local terrain, that the proper classification of solids within solids can establish a science of geology.

In 1678, Athanasius Kircher published a figure showing all letters of the alphabet, including the contraction Æ, etched in veins of calcite. Today, we chuckle and dismiss the well-formed letters as accidents. But to Kircher they were no less significant than the shells of clams also found in rocks. One might argue that clams are more complex than letters, but a Venetian work of 1708 depicted an agate that seemed to show, in its bands of color, Christ on the cross with all proper accouterments, including a sun on the favored right side and a moon on the despised left. The caption proclaimed in German doggerel: *Solche wunderbarliche Gestalt, hat die Natur in ein Agat gemahlt*—"Nature herself has painted this wonderful figure in an agate." Why was a clam in a rock different from a letter or a crucifixion? Since alphabets and religious scenes cannot be preexisting objects buried in strata, they must be made by a plastic power in the rocks themselves. As long as "odd things in rocks" formed a single category, clams and sharks' teeth would also be manifestations of the plastic force and no science of paleontology or of historical geology would be possible. But Steno's classification recognized the basic distinction between fossils that hardened before the rocks that enclosed them and intruding veins that might by accident resemble some abstract form or design.

Steno changed the world in the simplest and yet most profound way. He classified its objects differently.

Stephen Jay Gould teaches biology, geology, and the history of science at Harvard University.

What your home could have in common with the Met, the Tate, and the Louvre



Roberto Crabani's *Alla Stazione*, original lithograph. Signed limited edition of 175



Marc Chagall's *Le Tres Beau*, original lithograph. Signed limited edition of 50



Shimotakahara's *Green Tree Study*, original serigraph. Signed limited edition of 150



Johnny Friedlaender's *Verbatim*, original etching. Signed limited edition of 95

In your own home, you can exhibit original work by artists who are represented in the world's great museums and galleries.

Artists like Calder. Chagall. Dali. Miró. Picasso. Vasarely.

At the Original Print Collectors Group, we offer moderately priced limited edition prints by these and other well-known artists.

Our offerings include signed original etchings, engravings, and silk-screen prints.

Each print we offer is signed and numbered by the artist. Custom-framed. Accompanied by a certificate of authenticity and a full money-back guarantee.

And each print has been chosen not only for its beauty but for its investment value.

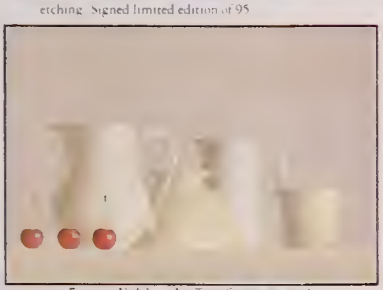
(Works by the artists we offer tend to appreciate, sometimes as much as 30% in a single year. Perhaps that's why *The Wall Street Journal*, *Business Week*, *Money*, AP, *Barron's* and UPI have quoted us as an authority on investing in art.)

For more information, send in the coupon. There's no obligation.

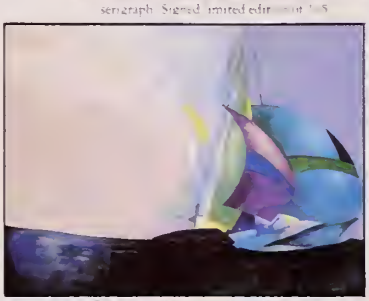
You'll find out about the special pleasure of owning original art, instead of just visiting it.



Artist's Pe... "Window", original serigraph. Signed, limited edition of 165



Francois Vidalens *Le Trois Cerises*, original lithograph. Signed limited edition of 175



Claude Gr... *Eve*, original lithograph. Signed, limited edition of 75



Andre Vigneles *Bouquet on the Table*, original lithograph. Signed limited edition of 190

Original print collectors group, Ltd.

215 LEXINGTON AVE., DEPT. NH-29, NEW YORK 10016

PLEASE SEND ME YOUR FREE COLOR CATALOGUE, LATEST NEWSLETTER AND OTHER INFORMATION

NAME _____
PLEASE PRINT

ADDRESS _____

CITY _____ ST _____ ZIP _____

© 1981 OPCG, LTD



Jean-Pierre Cass... lithograph. Signed, ... edition of ...

East African Safari

The quarry may be a lost identity that cannot be found in game parks

by Colin Turnbull

What is there about East Africa that drives thousands of tourists every year from comfortable homes in Japan, the Americas, and Europe and sends them flooding to Nairobi? What is it that transcends the cultural differences that these groups often seem to wish to exaggerate, rather than conceal, and gives them all the same air of expectancy and hope? And what is it that for many of them brings ultimate disappointment?

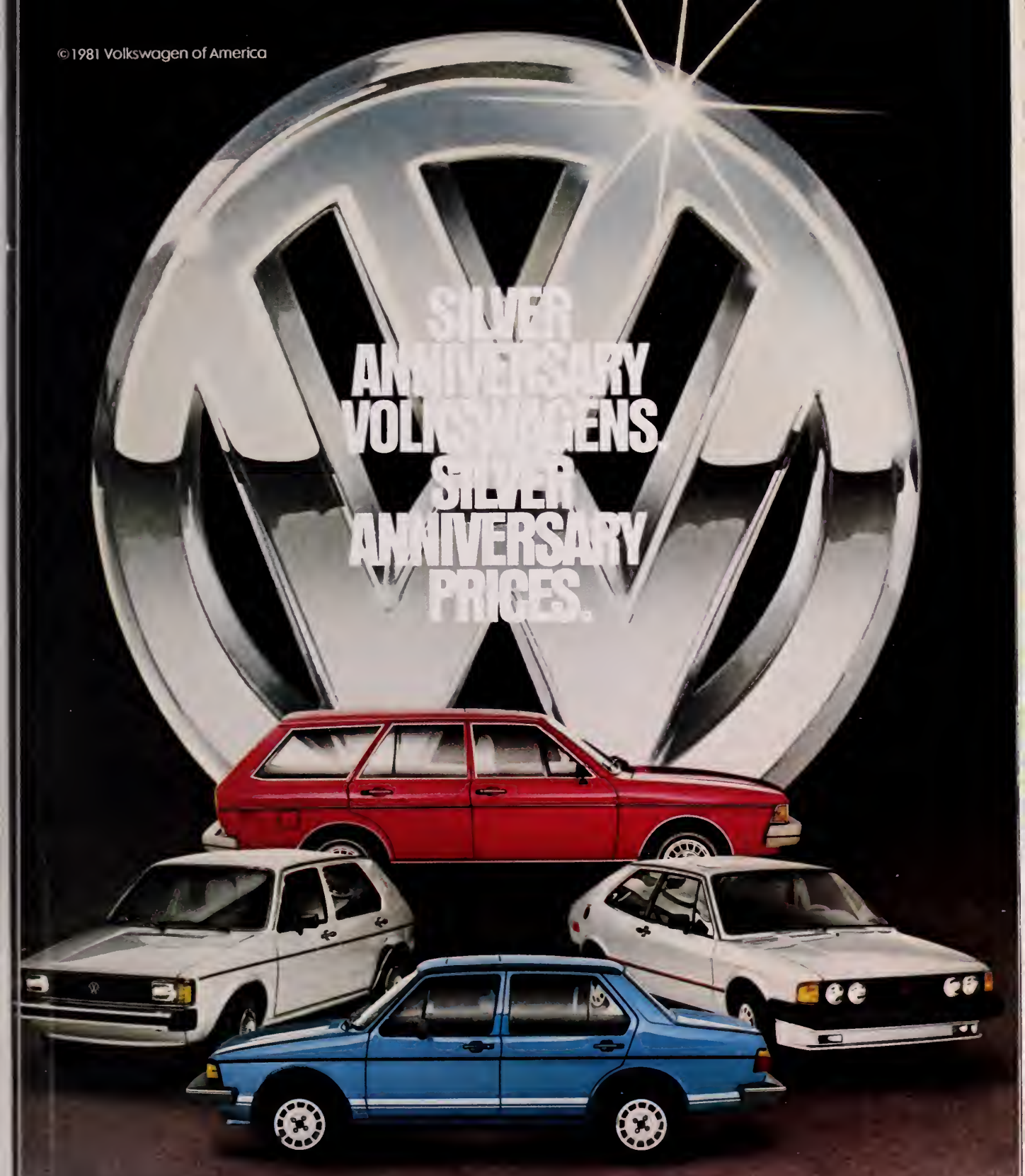
The search for an answer leads in many unexpected directions and shows how much the tourist is underestimated; how even when avowedly seeking escape, relaxation, and "fun," the tourist may be a pilgrim in search of something far greater. Some tourists deny this, insisting on their hedonism; others suspect the truth and are made uncomfortable, for the thought means that they may not, after all, have gotten what they came and paid for. The streets and hotels and bars of Nairobi are full of tourists, as are the cocktail lounges of every safari lodge. In one morning, in Barclay's Bank on Kenyatta Avenue, I met enough tourists to fill a book. They all had the same stated objectives: to see the animals, to see Africa, to see Mount Kilimanjaro. Since one would have to be blind not to see all of these things within twenty-four hours of arrival if desired, how is it possible to meet so many disillusioned tourists in one morning in one bank?

During a one-hour period I met two young French tourists who had abandoned their three-week safari after six days and were returning to Paris "because it is all too artificial . . . like an animated picture postcard"; a British couple who complained that "things are more natural and a bloody sight cheaper on the Yorkshire moors"; and a group of Californians who were already planning next year's holiday at Disneyland. It was difficult to find a tourist who did not suffer some disappointment, although it was often concealed beneath loudly voiced complaints directed at frustrating bank procedures or under enthusiastic comment on the grandeur of the scenery and the quantity of wildlife seen. There was plainly something lacking in the *quality* of the experience. One Frenchman said he had expected something more alive, more vital. The British couple kept harping on the "holiday camp" atmosphere and on human interference with nature. The Californians, interestingly, said they expected to find Disneyland both more "real" and more "natural."

There is, of course, something ironic in the very supposition that a game park is natural in any way. And the reference to Disneyland alerts us to the problem of separating most people's conception of reality from fantasy, which is often more powerful than empirical reality. Perhaps these tourists missed what they sought because they came prepared to rely primarily on one sense alone, that of sight. The came to *see* animals, Africa, and Kilimanjaro, and that is what they had accomplished. When I asked them what they had smelled, they were affronted. When I asked what they had heard, they recounted gossip, political comment, and barroom stories. And when I asked what they had touched, they considered the question too stupid to answer. Their awareness might have been greater had they been blind, for then they would have been forced to use their other senses, to interpret their own experience through the eyes of others. But at least they knew they had missed something.

Governmental policies and travel agencies are partly to blame. Thanks to lavish brochures and color posters, most tourists have "seen" it all long before they set out. The main difference is that in real life the game moves, the waterfalls fall, and the dancers jump and gyrate. In East Africa, the brochure is animated. The experience is like looking at a familiar home movie, sharing it with a large audience of other tourists seated in clusters of Land Rovers, minivans, and air-conditioned coaches. Governmental sensititivy to Africa's tribal past adds to the sense of artificiality and disappointment. Taking their cue from the West, most African governments equate tribalism and tradition with "backwardness." Yet, knowing the appeal of the so-called primitive, the same governments perpetuate the very myth of the backward native that they wish to dispel. Here we get a glimpse of some of the enormously powerful side effects of tourism, of its impact on governmental policy and the lives and welfare of whole populations. To satisfy the tourist demand for tangible evidence of Africa, the gift shops and boutiques are filled with tawdry trinkets that even at the most expensive best only barely resemble the greatness of a lost tradition. "Traditional" dances are staged that are a travesty

©1981 Volkswagen of America



Better get to a Volkswagen dealer like quicksilver. We're celebrating 25 years of being Volkswagen in America. In this festive mood, we're offering silver anniversary prices and deals on all our silver anniversary Volkswagens. Rabbit. Dasher. Scirocco. Jetta. Vanagon. And our super sporty Pickup. What a time to buy a Volkswagen. The price of silver may never be better.

VOLKSWAGEN CELEBRATES 25 YEARS OF BEING VOLKSWAGEN IN AMERICA.

Very easy to take.



HOPEWELL ROCKS, NEW BRUNSWICK



CAVENDISH, PRINCE EDWARD ISLAND



STEWIACKE RIVER, NOVA SCOTIA



WESTERN BROOK GORGE, NEWFOUNDLAND

Your family vacation in Canada's Atlantic provinces is very easy to take, for all kinds of very good reasons.

You are in easy driving distance of our provinces-by-the-sea. And when you cross our friendly border you'll find the roads a lot less crowded.

Or you can fly here. There are major airports in each of the four provinces with national car rentals available at each terminal. Or you can take the ferry. Drive aboard at Portland or Bar Harbor, Maine.

You'll quickly discover why people keep coming back.

Clean, fresh air and miles of uncrowded beaches. The kind of scenery that keeps cameras clicking, majestic highlands and rolling farmlands; silent fiords and tranquil fishing villages. And for a change of pace, sample city life as we live it. Remember, each of the four provinces also offers its own, unique attractions.

You can eat the freshest foods from land and sea. Spend your nights in a farmhouse, or snug in a home by the wave-washed shore. You can bring your tent or trailer, or take your pick from motels, hotels and fine resorts. You will also find your U.S. dollars are worth a whole lot more in Canada. Which means big savings on accommodation, meals, shopping and transportation.

You can swim, sail, golf, play tennis, fish; you can browse around, go to the theatre; or simply sit back and relax, knowing you are always welcome.

This vacation, come to Canada's Atlantic provinces. Very easy to take, but very hard to forget.

New Brunswick
Prince Edward Island
Nova Scotia
Newfoundland and Labrador



Atlantic Canada

For complete information: Seven days a week, 8 a.m. to 9 p.m. eastern time

CALL TOLL-FREE
1-800-341-0358

In Maine, call 1-800-492-0554

of all that dance used to be in African society. Once an integral and vital part of African social, religious, and political life, dance is now an empty mockery, choreographed to fit the limited floor space of a nightclub, gaudily costumed to satisfy a concept of propriety, new to Africa, that the West is fast leaving behind.

Most of the tourists I met clarified "seeing Africa" as *meeting* Africans, although some still insisted that they only wanted to *see* the people. But what Africans do most tourists see, other than hotel and tour employees or the costumed dancers, who are entertaining but quite unbelievable? They see Africans smartly dressed in Western-tailored clothing, sporting Western manners and Western speech. To many that is almost as unbelievable as the costumed dancers, and again they suspect artificiality. In any case, that Africa, clothed by Saville Row, is not what they came so far to see. "We thought it would be more primitive" is a frequently heard comment. It is an innocent observation, devoid of insult; for many, *primitive* conveys not so much backwardness as some kind of primal truth, referring to a state when man and nature lived in harmony, rather than locked in combat.

The Yorkshire moors may or may not be more natural than an East African game park, but clearly the English couple, and others like them, came searching for some kind of primal truth they had sensed elsewhere. The government and tourist agencies, however, make it next to impossible for average tourists to make effective contact with the Africa they hope to find. Motivated in part by considerations of image and financial profit, the agencies discourage the individual or family holiday on which it was once possible to drive freely across the African countryside, camping by the roadside, accepting the friendly and uncontrived hospitality of Africans in their rural villages, learning about Africa from them, seeing it as they see it, with their senses and sensitivity. Today it is almost impossible to avoid the organized group safari that leads the tourist from one air-conditioned luxury lodge to another, often providing a guaranteed "photographic bag" of every major form of game. Some safari lodges arrange for early morning wake-up calls as soon as the tourist's selected prey has obligingly presented itself for viewing from the

Be A Castaway



Miramichi River — New Brunswick

Streams seen and fished by few. Talk about trout and deep-sea fishing. Pick your fish, then pick your spot. The catch of the day or fresh lobster served all year round. Come on up.

Canada

SO MUCH TO GO FOR

For toll free information call: 1-800-341-0358 Maine Res. call: 1-800-492-0554

The triumphant saga of human-powered flight!



GOSSAMER ODYSSEY

by MORTON GROSSER

On June 12, 1979, the pedal-powered Gossamer Albatross flew across the English Channel. A member of the team that made it happen chronicles the astonishing engineering feats and the human drama behind the victory.

"The Wright Brothers would have been proud of this book."
—MARTIN CAIDIN

"The gripping story of the successful accomplishment of human-powered flight."
—GENERAL JIMMY DOOLITTLE

"Engrossing, reminiscent of the early days of flying."
—ANNE MORROW LINDBERG

Photographs • $14.95, now at your bookstore

HOUGHTON MIFFLIN COMPANY

2 Park St., Boston, Mass. 02107



Our handy knife-rule fits as neatly in your pocket as it fits your needs.

You've never owned anything like this. Not only is it a stainless steel pocket knife that's just 3" long and 3/16" thick when closed – with two blades of fine Sheffield steel. It's also a 6-inch precision rule engraved by Rabone-Chesterman of England, who are known the world over for precision rules. But, the best part of all? You don't have to go any further than your pocket for it.

Send for the Garrett Wade knife-rule and our full catalog. It's 116 pages of fine woodworking tools.

Offer expires September 15, 1981

Garrett Wade Co.,
Dept. NH-5-81
161 Ave. of the Americas,
New York, N.Y. 10013

☐ Please send me ____ pocket knife-rule(s) @ $31.50, p p d
☐ Please send me ____ new Garrett Wade catalog(s) @ $1.00 (free with pocket knife-rule order.)
_____ Amount enclosed. (Add sales tax for NY State residents.)
☐ Check/Money Order enclosed.
☐ Visa/Master Charge/American Express.

Card No. _____ Expires _____
NAME _____
ADDRESS _____
CITY _____
STATE _____ ZIP _____

hotel veranda, to be served up with morning coffee or tea, so to speak. All but the most devoted animal watchers are easily distracted by the drinks-while-you-wait approach. Indeed, many are sidetracked into using the photographic safari as an excuse for dressing up in safari suits and participating in a well-staged colonial period piece in which man is the hunter and the animals his prey. Moreover, the "natives" are guaranteed to be suitably subordinate.

In Nairobi, my colleague and I, both knowing East Africa well from many previous visits, attempted as tourists of moderate means to arrange a simple holiday that would avoid the luxury route and the organized group tours. No fewer than six safari firms said it was impossible. What they meant, of course, was that it would not be worth their while. We finally found a firm that booked us first into a do-it-yourself lodge in a game park and then into a tent camp by a bird sanctuary. Both were easily reached in a small rented car. The lodge, consisting of half a dozen separate furnished bungalows, was almost totally deserted during our week's stay. A mile away, in the same game park, the luxury hotel was full. From the open veranda of our small bungalow we saw every kind of game, mostly but by no means exclusively on the far side of a crocodile-filled stream, which ran through a gully fifty yards away. In fact, we saw more animals there than we did driving through the park, where other tourists were more prominent than the game. A park employee visited the lodge daily to make sure we had drinking water and kerosene for cooking. When off duty he accompanied us to a local market and introduced us to a variety of local foods, including some cooked in his own home. And he talked about his country and his people.

The tent camp was not such a success, consisting of a score or so of shabby tents, pitched under trees on the lawn of a hotel by the shores of a lake. The bedding was musty and damp, the mosquito netting torn, and the tents filled with every imaginable kind of insect. Toilets and bathrooms located behind the tents were barely usable. Only one other tent was occupied and that only temporarily and unofficially by amorous couples at night. Everything seemed designed to give us cause for complaint, and complaint was met by the European manager with the offhand suggestion that, if we did not like it, we could always move into the more expensive hotel, which she also ran. Thus, either by a systematic lack of publicity or by an equally systematic program of mismanagement, tourists are discouraged from going off on their own and are compelled to accept what is given. The individual safari, on which Africa can indeed be seen, is still possible but it takes a good deal of time and money. The average tourists—confined to the safari circuit and organized groups—are carefully kept at a distance from all that they observe: the animals, the land, the people. They are denied the opportunity many of them sought: to make contact with something of their not-so-remote past, when all people lived in harmony with the natural world, not in competition with it. They are denied the opportunity to escape from a world of artifice and manipulation, qualities without which neither the game park nor the safari circuit would exist.

To some extent we are all prisoners of our own culture; traveling to other lands gives us a chance to break out temporarily and briefly taste what it is to be not just somewhere else, but someone else. Tourists, however brief their visit, have the satisfaction of knowing that under other conditions they could have been other than they are; they discover an unknown potential by sharing in the cultural achievements of other humans.

Our longstanding fascination with animals is not so different from our fascination with other cultures and, of course, it is primarily the animals that bring tourists to East Africa. But it is more than just wildlife they seek, and the clues to the real nature of their quest lie all around. Deep in

WHEN YOU WRITE TO NATURAL HISTORY

about a subscription renewal, billing, or any kind of adjustment, please include your present address label.

Moving? Please notify 6 weeks in advance. Send your present address label along with your new address to Natural History Membership Services, Box 4300, Bergenfield, NJ 07621.

Name _____
New Address _____
_____
City _____ State _____ ZIP _____
Please Print Attach Label

our past, our ancestors painted on the walls of caves. They left us a vivid portrayal of man seeking and making contact with animals that goes far beyond simple depictions of the hunt, of hunters and their quarry. They also show us a powerful sense of kinship, a sense of two worlds that belong together. These worlds have somehow become wrongly and artificially separated. The ancient cave paintings show a perception of a power that is more than physical and testify to a belief that this power can be transferred from one world to the other. Neither humans nor beasts are shown as superior; both have their proper realm of potency. Our folk tales of today tell of animals acquiring human powers such as speech and abstract thought. In the days of our ancestors it was the other way around: we sought to acquire the power of other animals.

At the dawn of humankind, man and beast lived in much greater proximity. They sheltered in the same caves. In parts of East Africa, the skulls of the dead were until recently placed far in the rocky recesses of caves, as though human death were somehow mitigated through the ongoing presence of animal life. Today our concern for immortality (surely the greatest quest of all) is directed toward the stars. That is where we seek signs that we are not alone in the universe, that we are part of something infinitely greater and more enduring. Our cave-dwelling ancestors looked to the stars too, but they also looked to the animal world to find something of themselves there, seeking to find the fullness of their nature and the extent of their greatness and power. But that was before we domesticated animals and taught ourselves that we were superior. The tourist in East Africa may well be trying to reach back, searching for a lost identity and a sense, however tiny, of immortality.

The early interrelationship between man and beast, both affective and effective, mystical and practical, soon became formalized in complex systems of totem and taboo, systems that stressed the proximity of all living things, rather than their distance. The medieval European system of heraldry perpetuated the notion of a mystical bond between families of men and families of animals. And today, we have bestial national emblems and royal or sacred, protected species. Play and dance, both highly educational

The Sunny North



Georgian Bay Ontario

Parks, cabins, cottages and grand resorts that let you pick and choose. Water sports, hiking, camping and fishing. As tame or as wild as you like. Come on up.

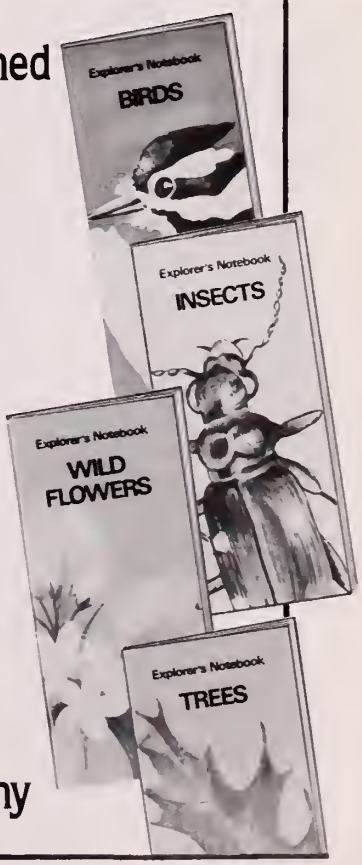
Canada

SO MUCH TO GO FOR

For information call collect: 416-965-4008

Turn novice nature watchers into accomplished naturalists with

EXPLORER'S NOTEBOOKS



These full-color, pocket-sized, easy-to-use guides will help beginning hikers, campers, and bird watchers spot and record their sightings. Each book identifies over two dozen common species of birds, trees, wild flowers, or insects. And each includes brief, non-technical descriptions of species and their habitats plus detailed illustrations and space for notations.

Each: Ages 10 up. $1.95 paperback

Available at bookstores

Little, Brown and Company

34 Beacon Street, Boston, MA 02106

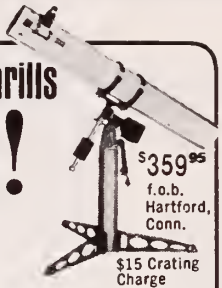


Pentax binoculars separate the bird from the bush.

A Bittern sits motionless, challenging you to pick him out from a background that seems to match him perfectly. Now you need the razor sharp optics, high contrast and superb color rendition of Pentax 8x30 Lightweight Binoculars. Fully coated, perfectly matched optics, fold-over eyecups for eyeglass wearers. Lifetime warranty. See the difference at sporting goods dealers or write Pentax Corporation, Englewood, CO 80112.

PENTAX BINOCULARS

Share the Thrills of Exploring Outer Space!



$359.95 f.o.b. Hartford, Conn.

$15 Crating Charge

Now it's easy to join the thousands of serious amateurs who have discovered the excitement of exploring our mysterious universe. Your enjoyment begins right from the start, yet the challenges and rewards go on for years! And it's a hobby that can be shared at modest cost.

Choose From Many DYNASCOPES®

Picking a telescope to fit your needs and your pocketbook is simple when you select a DYNASCOPE—the same instruments used by more than 150 schools, colleges and observatories—and your satisfaction is guaranteed by a full-refund warranty.

FASCINATING GUIDE YOURS FREE!

Read these valuable facts before buying any telescope. Mail coupon or postcard for your complimentary copy of this helpful guide.



Criterion Manufacturing Co
620 Oakwood Ave., W Hartford, Conn 06110

® TM Registered U.S. Pat. Office

CRITERION MANUFACTURING CO., Dept NH 103
620 Oakwood Avenue., W Hartford, Conn 06110
Please send your free Telescope Guide.

Name_____

Address_____

City_____ State_____

WILD FINNISH ADVENTURES FOR HIKERS, BIKERS, CANOERS & SAILORS.

To: Finnair, P.O. Box 32,
Irvington, N.Y. 10533

Please rush me your free color brochure on Finland Adventure Tours for hikers, bikers, canoers and sailors before I go wild.

Name _____

Street _____

City _____

State _____ Zip_____

FINNAIR

Great vacations start with the Flying Finnish

NH5

activities, still relate us to the animal world, although perhaps less directly than in East Africa, where the play-*bomas* teach children how to identify an almost unlimited variety of cattle and where dances in imitation of fighting bulls may serve to explore and resolve disputes between humans. Leapfrog is still with us, as is the ancient game of snakes and ladders.

Right up to the present day the animal world has been kept at the forefront of our consciousness, as it was in the earliest times, by a body of mythology that has connected humans with beasts, deliberately blurring the lines of distinction. The Greeks, among many other peoples, suggested that gods mated with humans, resulting in creatures that were half human and half beast, and therefore semidivine.

When we look at the Middle Ages in Europe, we get a better perspective on our ongoing involvement with animal imagery, one that suggests that throughout history some human beings, at least, have seen animals as intermediaries, as vehicles to attaining a power exceeding that of ordinary mortals. Animal symbolism flourished in both the sacred and the secular worlds. While the Christian Son of God was portrayed as a lamb, the Antichrist was portrayed as the lamb's cousin, the goat. The Devil was believed to seduce both male and female while in the form of a goat rather than in human form, suggesting that in animal form he was even more powerful. Medieval court records overflow with the testimony of accused asserting that they had voluntary carnal relations with the Devil or one of his agents, who appeared in a remarkable diversity of animal forms. The conjunction of human and beast was believed to lead to a creature of supranatural rather than supernatural power, and some actively sought power in this way.

Animals were tried alongside their human companions and not infrequently executed with them. Just to keep a pet or feed a stray cat was often enough to warrant an accusation of consorting with the Devil, for the real intimacy that was feared was spiritual, rot physical. Such intimacy led to a transfer of powers that, in the Middle Ages, was thought to result in evil, since the conjuction of human and beast had never been intended by the Divine Creator. Man was reaching too far, committing a blasphemy,

just as some today feel that man is committing a blasphemy in reaching for the stars. Yet so deep-seated is this yearning for a sense of intimacy with all other living things that even today, when we would laugh at the notion of consorting with the Devil or of acquiring supranatural powers through the use of a familiar (a spirit, often in animal form), we still persist in the attempt to bridge the gap between the two worlds. The depictions of animals in children's books, comic strips, and animated films are only some of the ways we make contact, under pretense of fantasy. What did those Californians mean when they said that Disneyland was both more "real" and more "natural" other than that, for them, it united the two worlds more readily than mere observation of live animals in a game park? Disneyland gives life to the ancient fantasy of oneness, but in a way that is respectable. It makes the gap between the two worlds seem less important, if not nonexistent.

Is it really too much to suggest a connection between medieval concepts of witchcraft power and contemporary fascination with animal imagery as represented by Disneyland? What of the deeply entrenched custom of keeping pets? Consider the possibility that we all have our own familiars; it is not difficult to see that in our favored animal form we find qualities that we admire or envy or fear, that we feel to be latent within us and that, through association and proximity, we hope to control or bring to the surface. For many, the pet becomes almost an alter ego.

Everywhere we look, from the cave paintings of the remote past through the mythology of the ancients, in the witchcraft beliefs of our immediate ancestors, and even in our own contemporary customs and usages, we are surrounded by animal imagery, whose significance we dismiss only today. The tourist in East Africa can hardly avoid being affected by this pervasive imagery and may well be trying, however unconsciously, to abolish the distance and separation that modern man has created, a distance that far from ennobling us seems to diminish us. In seeking proximity to that other world or that other part of our own world, tourists may not be in search of supranatural power but are surely seeking to enlarge their own sense of being. And in those rare moments of solitude, the tourist can scarcely fail

Rocky Mountain High



Purcell Range — British Columbia

Superlative scenery. Mountains, fjords, glaciers and waterfalls. Countless rivers and coastal streams spawning salmon. Totem poles overseeing all, from hidden places. Come on up.

Canada
SO MUCH TO GO FOR

Tourism British Columbia, 1117 Wharf St., Victoria, B.C. V8W 2Z2



Estelle B. Freedman
THEIR SISTERS' KEEPERS
Women's Prison Reform in America, 1830-1930

One woman, an inmate. Because she was poor and unequal before the law. And because she was victimized by men. The other woman, her sisters' keeper, perhaps a leader in the fight to set up a separate system of prisons, run by and for women. This study of prison reform adds a new chapter to the history of the development of feminist consciousness and the struggle for justice in America

Women and Culture Series

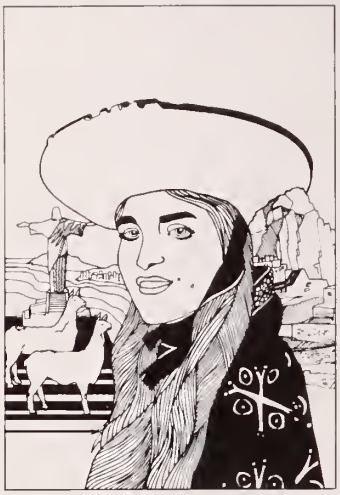
$18.50

The University of Michigan Press
Dept. CJ P.O. Box 1104 Ann Arbor MI 48106

Fine Woodworking

The magazine about making beautiful things out of wood

Woodworkers' delight—A subscription to *Fine Woodworking* brings an abundance of ideas and information on cabinetmaking, carving, marquetry and turning—the tools and techniques, materials and design. Carefully edited, beautifully printed. Join the 200,000 readers of this superb bimonthly magazine by sending your name and address, along with your payment, to The Taunton Press, 52 Church Hill Road, Box 355C6, Newtown, CT 06470. One year $14, two years $26, refundable. For gifts, please include both addresses. Visa or Master Charge accepted.



Maupintour's
South America

HIGH QUALITY escorted tours. In-depth sightseeing, best hotels, unique dine-outs, entertainments, limited size.

DARWIN'S GALAPAGOS on 5 different programs from 14 to 19 days. Combine a Galapagos cruise aboard the new Santa Cruz with Indian markets, Amazon port towns, Panama's primitive San Blas Isles, hidden Machu Picchu, Bolivia's Lake Titicaca or mysterious Easter Island.

22-DAY GRAND SURVEY of South America's most interesting places. Bogota, Quito, volcanoes, Indian markets, Lima, Cuzco, Machu Picchu, Santiago, Asuncion, Iguassu Falls, Brasilia, finale in Rio de Janeiro.

SEND THIS COUPON to Maupintour for the brochures checked or ask your favorite Travel Agent.

☐ Alaska ☐ Africa ☐ Canada ☐ USA
☐ Europe ☐ California ☐ Pacific NW
☐ Colorado ☐ Arizona ☐ New Mexico
☐ South America ☐ Mexico ☐ Festivals
☐ British Isles ☐ Middle East ☐ India
☐ Fall Foliage ☐ Spain ☐ Orient/Pacific
☐ Australia ☐ Scandinavia ☐ Greece
☐

USTOA United States Tour Operators Association

Maupintour
quality escorted tours since 1951

Maupintour, 900 Massachusetts St., Lawrence, Ks. 66044. 800-255-4266.

name

address

city

state/zip

my travel agent *nhs-sam-1*

to glimpse the full potential that comes to us all when we see ourselves as a small but essential part of a world much wider and grander than the one that we have manufactured exclusively for ourselves.

When tourists add "Africa" and "Kilimanjaro" to "animals" on their list of objectives in coming to East Africa, they seem to me to be plainly stating one objective, not three. They expect an indivisible, natural whole made up of both human and animal components. But unless they are unusually lucky this is not what tourists find on the organized safari. All that is observed is man-made: game parks devoid of the herders and hunters who used to live there as an indispensable part of the ecosystem. The movements of the game itself have been distorted by, or adapted to, the movement and behavior of tourists in their variety of vehicles. The animals, far from retaining their independence, have in every sense become as dependent as pets, for we have taken control of all that lives and moves and dies in the park. Even Kilimanjaro, seemingly majestic as ever, has lost something, for the greatness of that mountain lies not so much in its height and grandeur but in the beliefs and hopes of those who live on its slopes and in the plains stretching far into Africa on all sides. Many of those people have been moved in the name of progress (and tourism), their whole way of life has been changed, their beliefs taken from them. To know Kilimanjaro is not just to see it, but to touch it, say, through the life of an old man or woman to whom it is still sacred. And that is precisely the way to know the animals in Africa.

To know the wildlife is to float down the Semliki in a canoe with men whose harpoons are poised, waiting for the reeds that some hold between their fingers to betray the presence of a submerged hippopotamus. Then you will know that animal as you can never know it by watching it yawn in the muddy waters of a game park puddle. And as the harpooned, still submerged hippopotamus takes off, towing the canoe at the speed of a powerboat, you will come to know what it is to be the hunter, full of respect and compassion for the prey. Without the hunter the game park is just another Disneyland, another of man's fantasies. The hunter kneeling in a canoe, standing high on an anthill, or climbing a solitary tree in search of a possible kill is an essential part of the world the tourist really wants to know.

I met some tourists who specifically came to recapture something of what they see as their lost identity, man the hunter. Many of them had previously been on big game hunts, but having had their share of killing had been left unsatisfied. The hunter of our past was strangely nonviolent; he killed with no animosity, no sense of superiority, only because it was necessary to survive. Not far away, across the border of Uganda and into Zaïre, live the Mbuti, a people who, with a pre–Stone Age technology, still survive by hunting and gathering. They tell a story of how God created all living things—animal, vegetable, and mineral—endowing them with different degrees of life force but making them all immortal. Then one day, one of these living creatures, man, killed an antelope. And although he and his family consumed the animal entirely, making use of all its parts so that none went to waste, God cursed the day and ordained that from then on all animals, including humans, would die. Since that day, the Mbuti say, they have had to kill to survive, but they kill only the minimum they need for each day, saving nothing for the morrow, in the hope that if only they can learn again how to survive without killing their fellow creatures, they may regain their immortality.

A thousand miles away the Bushmen, whose ancestors may well have come from the plains below Kilimanjaro, tell an almost identical story. The experience of human beings living as an integral part of a connected, natural world is what pilgrims/tourists mainly seek when they come to Africa. The animals are the means by which the culture-bound pilgrim can grow and expand, sensing a unity with all other living things and finding a greater potential through another source of power. And if our history tells us anything, if there is anything to be found in the art and literature of all ages, it is that through contact with the animal world we can touch the mystery of life itself and for a fragile moment know what it is to be semidivine, immortal.

Colin Turnbull, formerly associate curator of African ethnology at the American Museum of Natural History, is visiting professor of anthropology at George Washington University.

In fine pewter, painted by hand

The Songbird Miniatures

by Anthony J. Rudisill

Enchanting, jewel-like beauty in sculptured form . . .

Twelve songbird miniatures, each one an original work of art in hand-painted pewter . . .

A superb display, a focus for conversation and admiration in the most elegant room

A darting flash of brilliant color. A lilting melody as pure and clear as fresh spring water. The *songbird.* Admired and cherished for its grace and beauty. Painted and sculpted throughout the ages in works of art collectors watch for with special keenness.

And now created in one of the most fascinating, most beautiful forms of all. Combining the rich color of painting . . . the three-dimensional realism of sculpture . . . and the unique charm and appeal of the traditional *fine art miniature.*

'The Songbird Miniatures' collection is the creation of the noted wildlife artist, Anthony J. Rudisill, whose work is frequently commissioned by the National Wildlife Federation. It is his very *first* work for the medium of pewter — selected for its unique ability to capture fine detail. And it is the *first* such collection issued by The Franklin Mint.

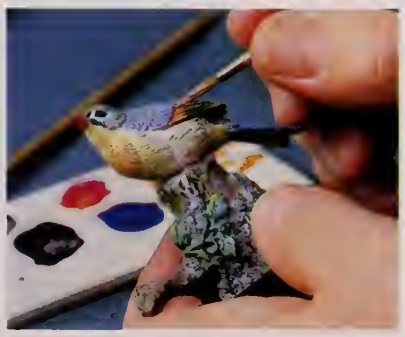
Rich, hand-painted colors

The collection comprises twelve beautiful songbirds from around the world . . . each sculptured in intricate detail and with a powerful sense of realism.

To ensure that the artist's designs are reflected with complete faithfulness, each pewter miniature will be cast by master craftsmen in Malaysia . . . specially chased and finished . . . meticulously *painted by hand* in colors having all the richness and subtlety of nature . . . and coated with a protective finish to permanently preserve the sculpture's true-to-life appearance.

A limited edition

'The Songbird Miniatures' will be issued in a limited edition, available exclusively from The Franklin Mint and only for one year, until May 1982. After all valid subscriptions have been fulfilled, the molds will be broken. Thus the total number of collections issued will be permanently limited to the exact number of applications received during the subscription period.











Each songbird is sculptured exactly one-half life size in a natural setting, and hand-painted in Nature's own colors

Advance subscription deadline: May 31, 1981

You are among the first to have the opportunity of acquiring 'The Songbird Miniatures'. But please note that the advance subscription application at right must be postmarked by May 31, 1981. As a subscriber you will be able to build your collection systematically, receiving one songbird miniature every other month. And the issue price for each sculpture — just $45, remarkable indeed for an original work of this quality — will be billed to you in two convenient monthly installments of $22.50 each.

But please note that the application at right should be signed and mailed to The Franklin Mint, Franklin Center, Pennsylvania 19091, by May 31st.

© 1981 FM

ADVANCE SUBSCRIPTION APPLICATION

Valid only if postmarked by May 31, 1981.
Limit: One collection per subscriber.

The Franklin Mint
Franklin Center, Pennsylvania 19091

Please enter my subscription for 'The Songbird Miniatures', a collection of twelve miniature sculptures cast in fine pewter and hand-painted. The miniatures will be sent to me at the rate of one every other month.

I understand that I need send no money now. I will be billed for each miniature in two equal monthly installments of $22.50*, the first installment being due in advance of shipment. I may return any figure within thirty days for replacement or full refund.

**Plus my state sales tax and $1. per shipment for postage and handling*

Signature _____
ALL ORDERS ARE SUBJECT TO ACCEPTANCE

Mr.
Mrs.
Miss _____
PLEASE PRINT CLEARLY

Address _____

City _____

State, Zip _____

Life Returns to Mount St. Helens

One year after a major eruption turned much of the mountain into an apparent grave, the slopes show abundant signs of resurrection

by Roger del Moral

Picking my way across a dry and barren mudflow 5,000 feet up on the slopes of Mount St. Helens last September, only four months after the eruption that devastated the mountain and far from any visible vegetation, I discovered an isolated, yet active, ant nest. These ants, probably *Formica subnuda,* were at the top of a food chain whose lower levels, hidden in the mudflow, were unknown. Decomposing organisms and living plants may have formed the base of the chain, but without disturbing the nest, I could not determine whether soil animals or fungi were involved. Despite my curiosity, I decided that my ignorance was less important than the existence of this microcosmic ecosystem in a veritable desert. The ants were adding nutrients to the mud and hastening the reestablishment of less ad hoc food chains. After watching the activities of these tiny survivors for a while, I continued up the slope, searching for signs of life among the ruins of what was once the most perfect of the Cascade volcanoes.

As Mount St. Helens marks the first anniversary of its May 18, 1980, eruption, it has already been exposed to more hours of scientific scrutiny than most volcanoes are ever subjected to. Logistical and technical problems plagued efforts to study earlier eruptions of other North American volcanoes. Mount Katmai in Alaska, for example, erupted in 1912, but ecologist R. F. Griggs (to whom scientists owe a major debt for his pioneering botanical and geologic studies of that volcano) was unable to approach the mountain until 1916. By contrast, the proximity of Mount St. Helens to scientific centers provides a rare opportunity to apply advanced methods in comprehensive, long-term studies of how ecosystems recover after a major volcanic eruption.

As an ecologist interested in competition and succession in stressful environments, I found myself among the hundreds of scientists drawn to the mountain by the opportunity to document in detail the recovery process and by the exciting chance to test ecological, evolutionary, and biogeographical hypotheses. Biologists observing events as they unfold on Mount St. Helens are asking many questions: Which species first colonize the various completely destroyed habitats? Are succession processes on totally denuded sites fundamentally different from processes on sites with a residual biota? Does repeated extinction and recolonization result in populations that are genetically distinct from populations of the same species in stable habitats? Might communities whose species occur in proportions different from the regional norm be produced?

Ray Atkeson



Above: Residents of Portland, Oregon, had a spectacular view of the July 22, 1980, eruption of Mount St. Helens, one of several sizable blasts that followed the major eruption of May 18. The mountain's proximity to urban centers has been a boon to scientists. Right: Two months after the May 18 eruption, a parsley fern was found growing in a protected area along a creek on the slope of the mountain. The fern, which survived a small mudflow, is growing out of a mud-covered crevice.

My first field experience on the volcano after the eruption was on a reconnaissance trip last July with Jerry Franklin of the U.S. Forest Service and several other biologists. While we were awed by the magnitude of the destruction, I was impressed even then by the early evidence of biological recovery. Since that time, I have made several research trips into various parts of the volcano's "red zone" (the Forest Service's designation for the potentially most dangerous land, to which access is closely controlled). I have also spoken with many other scientists investigating resurrection on the mountain. The emerging picture is one of diversity—diversity of impact and, consequently, of the conditions to which organisms must adapt. Al-

Roger del Moral

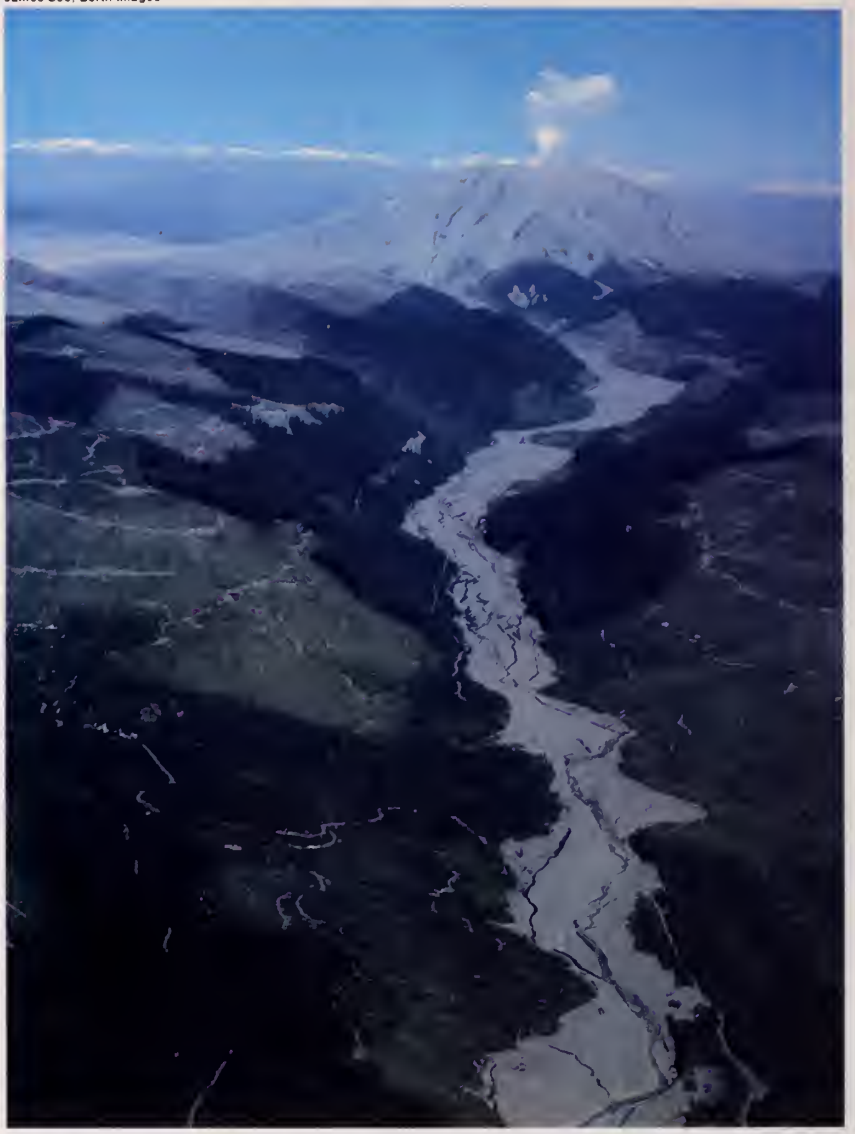


titude and season influenced the nature and extent of the damage suffered by different parts of the mountain. In May, much of the landscape was still covered with snow. By contrast, when I visited the volcano late in the summer of 1980 after a minor eruption, I found that hot-gas emissions had scorched exposed plants. These withered bits of straw provided an inkling of what might happen if a big eruption occurred when there was no snowpack to cushion the blow.

The May 18 eruption, like subsequent smaller eruptions, was a series of events, each producing different conditions. In some places, biotic recovery has begun with survivors; in others, colonizers from outside the impacted zone are required. Many ecosystems won't return to anything resembling their preeruption state for years. But almost all affected ecosystems are showing resilience, and the message is clear: while it took a beating, life was never obliterated from Mount St. Helens.

The eruption, which followed two months of relatively minor volcanic activity, unexpectedly concentrated its force on the land to the north. Although geologists had anticipated a major eruption and the magnitude of the blast was not unprecedented, no one was prepared for the degree of devastation spawned by the unusual lateral direction of the eruption. More than a cubic mile of ash was injected into the atmosphere, eventually coating hundreds of square miles of forest and agricultural land. Millions of insects were knocked dead from the sky. Heat scorched trees up to sixteen miles north of the crater, and the blast blew down trees in an arc of 160 degrees, extending more than ten miles from the crater. In most areas within a six-mile radius of the crater all life was destroyed. Large, rapid mudflows, confined to the lower elevations of several of the mountain's major stream systems, crested over twenty-five feet and buried the flood plains of the Muddy River to the east and both forks of the Toutle River to the west. A flow of hot debris then swept all life from the northern flank of the mountain and the upper Toutle Valley, creating an eerie moonscape. (Unlike the sterile surface of the moon, however, the debris is rich in organic residuals.) Melting glaciers and snowfields triggered smaller mudflows on the upper slopes. For example, on the southeast flank of the mountain, the melting of Shoestring Glacier caused a mudflow along Pine Creek that covered vegetation on the edges of the creek while removing it from the creek bed. In total, the eruption of Mount St. Helens had a profound impact on a region of about 160 square miles.

James Lee, Earth Images



The number of animals killed as a direct result of the explosion was high. Subterranean animals, such as pocket gophers, appear to have survived in many places even within the blast zone, but mammals and birds living above ground had no protection from the blast. The Washington Department of Game estimates that among the more prominent casualties were 5,200 elk, 6,000 black-tailed deer, 200 black bears, 11,000 hares, 15 mountain lions, 300 bobcats, 27,000 grouse, and 1,400 coyotes; the agency has estimated heavy additional losses due to ashfall. The eruption also severely damaged twenty-six lakes and killed some eleven million fish, including trout and young salmon.

Animals outside the blasted areas must contend with altered habitats and reduced quantities and quality of food. In the blowdown zone, elk and deer are now common near water and where fresh forage has emerged from the ash. These survivors may have to forage more widely, but their reduced numbers will ease competition stresses. Zoologists expect the populations of vertebrates to build up as the vegetation recovers, and they are hoping to determine how much the vertebrate pioneers may change their behavior with respect to habitat and resource use as their numbers increase. Significant changes in behavior would constitute evidence for interspecific competition, normally difficult to observe in nature.

Ralph Perry



Far left: Twelve miles or so west of Mount St. Helens (visible in the distance), clear-cut and forested areas along the North Fork of the Toutle River escaped direct effects of the eruption. Large, rapid mudflows, however, buried the river's flood plain. Left: Closer to the volcano, trees were blown down and a hot debris flow, placed on top of the mudflow, swept all life from the upper Toutle Valley.

Larger vertebrates may form a crucial link in the process of vegetation recolonization. Where heavy ash or mudflows dried to form a hard, uniform crust, there are few cracks to shelter germinating seeds. But large animals wandering in search of food or water make tracks that trap seeds and provide microsites suitably mitigated for germination and growth.

Insects suffered incalculable tolls, primarily from the ash effects of the May 18 eruption and from sizable blasts that occurred on May 25 and June 12. Abrasion of the exoskeleton and ingestion of ash during preening were major causes of death. Studies of agricultural areas in central Washington have revealed that although honeybees and other beneficial insects suffered greatly, most insect populations recovered quickly. Nearer Mount St. Helens, where higher altitudes mean a later spring, fewer insects were exposed at the time of the eruption. In the blowdown area, many species have been encountered, but except near water, their numbers are reduced. I noted that seed set in lupines, which are dependent on insects for outcrossing (the production of offspring from individuals of the same species but different strains), was poor even where the vegetation received little damage. I believe this poor seed production was a result of the relative paucity of pollinating insects.

Insect colonists will come from pools of insects outside the blast zone, and new insect communities will eventually develop. Will these communities be similar in species number and composition to communities in similar but unaffected habitats? Daniel Simberloff's experiments during the 1960s, in which all insects were removed from a series of very small Florida keys, indicate that such communities will soon return to the same number of species but that the composition, largely a matter of chance, will be quite different. In the Mount St. Helens blast zone, the habitat is larger than in the island experiments and there is no significant barrier to migration. Will this alter the results? Will novel, stable assemblages of insects be formed?

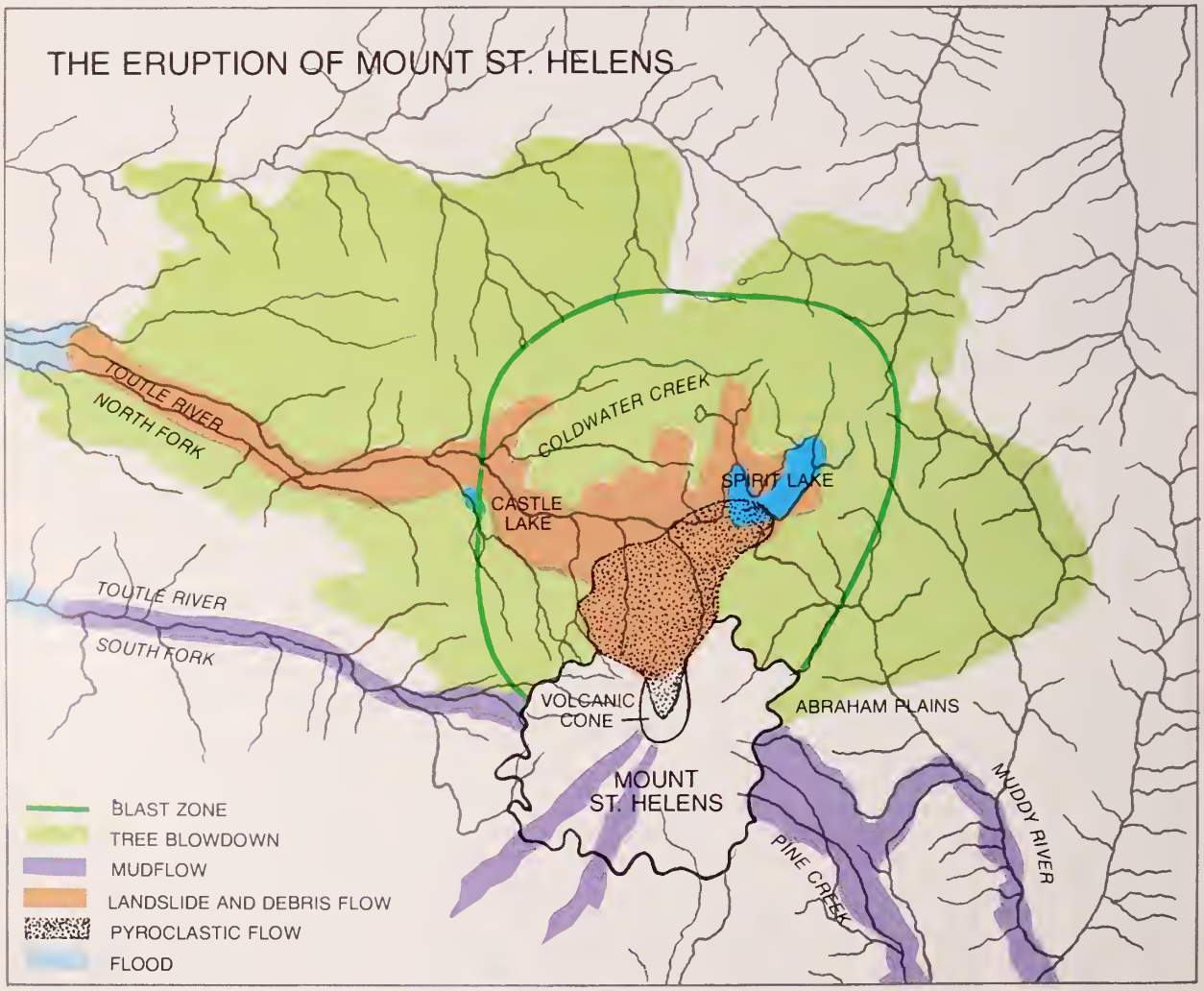
Food limitations present surviving insects and early immigrants with unique challenges. Species with the most generalized requirements are predicted to be successful, and some early observations in the blowdown area support the idea that survival requires adaptability. In the weeks after the big eruption, when ash was ubiquitous and aphids were rare, Jerry Franklin and I observed a ladybug, normally an aphid predator, feeding directly on the sap of a bracken fern (*Pteridium aquilinum*) that had emerged from the ash. Such short-circuited food chains should return to normal as the vegetation, on which aphids and other herbivores depend, recovers.

Because insects have short generation times and are often early colonizers, entomologists are likely to observe microevolutionary events, which involve shifts in gene frequency rather than speciation. For example, where biotic recovery requires immigration, the first individuals of a species to invade an area are, not surprisingly, usually the best able to disperse. Reduced competition and the absence of predators in their new environment may permit a "founder effect" to occur, that is, the genetic differences between founding individuals and the average members of the donor population become fixed. Such differences will probably be minor, but if they occur repeatedly in many species, biogeographical processes that are known to operate between islands will have been shown to be significant for evolutionary processes in terrestrial situations as well.

The effects of the eruption on vegetation in various zones are also under study. In forests within a few miles of the mountain, the initial ash deposits fell wet because of eruption-induced thunderstorms and covered the trees and ground with a thick goo, which soon dried to form an impervious, cementlike layer. Ash on vegetation interrupts gas exchange and curtails photosynthesis. Jini Seymour of the University of Washington measured temperature in ash-coated silver firs (*Abies amabilis*) and found them to be more than 30°F warmer than adjacent leaves from which the ash had been removed. Fortunately, since heavy ash fell prior to bud burst in higher elevations, much ash-free new growth is now present in most of the surrounding forest. As ash-covered leaves are washed clean by precipitation or replaced by new growth, conifer productivity should return to normal. Some species, such as red cedar (*Thuja plicata*), retain ash more tenaciously than others, such as Douglas fir (*Pseudotsuga menziesii*), but

Eyewitness accounts, photographs, and instrument records have been used to piece together the initial sequence of the May 18, 1980, eruption of Mount St. Helens, the youngest and most active Cascade volcano. A huge bulge formed rapidly, high on the north face of the mountain's volcanic cone, in the weeks prior to May 18. Then, at 8:32 A.M. on that day, an earthquake struck the mountain, triggering an avalanche on the north face that is now thought to be the largest ever witnessed by humans. Superheated groundwater close to the magma flashed into steam, resulting in a lateral explosion that pulverized rock and trees and sent a hurricane-force, hot-gas-propelled bolt of ash off the north face and across the Toutle River Valley to the north and west. Temperatures in this inferno were estimated to exceed 900° F. Comparable to a 400 megaton nuclear blast, the explosion blew down trees in a 160° arc up to fourteen miles north of the crater and totally devastated a somewhat smaller "blast zone." Seconds later, overlying rocks were incorporated into a high-velocity debris flow, driven by rapidly melting glacial ice. On the western flank of the mountain, this chocolate-colored mass swept down the upper Toutle River Valley, eventually forming a mudflow that swept the entire drainage area. To the north, a lobe of this hot debris flow crashed into Spirit Lake while another swept over 500-foot-high Coldwater Ridge, removing all life in its path. As the summit of the mountain collapsed, two vertical columns of ash-laden gas and steam were injected more than 65,000 feet into the air. This ash was eventually deposited, in layers up to five inches thick, over 49 percent of Washington State and beyond. Close to the mountain, ash deposits were less thick, but they fell wet, forming a sticky goo on all surfaces. The plume of blasted ash also removed much of the remaining summit and lowered the peak from 9,677 feet to about 8,400 feet. As a consequence, the feeding zone of all glaciers has disappeared. Shortly after these events and continuing throughout the next day, an indeterminate number of pyroclastic flows, or nuées ardentes *(hot, gas-charged avalanches of fluidized rock fragments), were ejected from the crater, so that much of the upper debris flow was covered with more than seventy feet of finely powdered ash and pumice.*

The volcano remains active, with frequent small, harmonic tremors and occasional bursts of steam and ash. Sizable eruptions, with their attendant small pyroclastic and pumice flows, occurred on May 25, June 12, July 22, August 7, October 17 and 18, and December 27 of last year. Future eruptions are expected, but most geologists believe that another large eruption is not likely.



whether various species of forest trees will show important differences in mortality or productivity is not yet clear.

At higher elevations, snow protected the plants beneath the canopy of forest trees from direct ash deposits, but impacts still accrued in this understory vegetation. Many plant species already flattened by snow were trapped by heavy ash. Erosion and rain may eventually remove sufficient ash to free such plants, but the damage may have been too severe or too much of the growing season may have passed for them to survive. Mosses and lichens, which form low mats, are the most severely damaged. Other species, such as the erect-growing huckleberries (*Vaccinium* spp.), were able to emerge from the ash layer as the snow melted. These plants grew well during 1980, probably because there was less competition from other plants and because the high insect mortality reduced grazing pressure. Many of these emergents have sent roots into the nutrient-rich ash and may thus benefit directly from improved nutrition.

Jim MacMahon of Utah State University has shown that pocket gophers are major agents of ash-layer disruption. These little burrowing rodents improve soil aeration and water infiltration. As a consequence, minerals from ash are more rapidly incorporated into the soil, where they can be used by plants. Silviculturists normally view pocket gophers as unmitigated pests because they eat young conifers, but for the next few years, gophers may prove valuable allies in the reestablishment of tree seedlings in clear-cuts and blowdown areas.

For most plant species, recovery in heavily ashed areas will be rapid. Young Douglas firs, silver firs, and noble firs (*Abies procera*) may suffer heavy mortality, and species of lichens, mosses, and other low-growing plants will be disproportionately rare for many years, but overall forest productivity should soon return to pre-eruption levels. When nutrients from the ash, such as phosphorus and potassium, are added to the soil, they may actually generate a pulse of enhanced productivity. Understanding the differential effects of Mount St. Helens' ash deposits on vegetation will improve the ability of ecologists to read the history encoded in tree rings, pollen records, and soil profiles in other volcano-dominated ecosystems.

Less apt to survive than trees that were primarily subjected to ash deposits are the scorched conifers found in a narrow but expanding band between green timber and standing dead trees. Many trees in this border zone, such as western hemlock (*Tsuga heterophylla*), Douglas fir, and noble fir, survived the initial surge of heat and gas from the main eruption but were weakened by it and also received heavy ash deposits. During the dry summer, many trees gradually succumbed from internal heat or other factors. Fortunately, young saplings beneath many of these trees escaped virtually unscathed by virtue of the snowpack present during the eruption. Thus, the next conifer generation is already well established and should experience a burst of growth now that the saplings are released from competition with their parents.

Still closer to the volcano, where stands of large trees did not survive the first blast, stark contrasts appear between areas that had been clear-cut shortly before the eruption and areas that had been covered with forest. In most parts of the blowdown area, snow again offered some protection to ground-layer vegetation, and terrain closest to the mountain received less ash than more distant areas directly in the path of fallout. In the clear-cut areas, regeneration of herbaceous vegetation began shortly after the eruption. Species that commonly grow on recent clear-cuts, such as fireweed (*Epilobium angustifolium*), pearly everlasting (*Anaphalis margaritacea*), and bracken fern, have ecological characteristics distinct from those of forest understories. They grow fast, produce many easily dispersed seeds, and are able to colonize newly disturbed sites rapidly, tolerating high light, high temperatures, and drought.

In contrast, areas in the blowdown region that were covered by deep forest at the time of the eruption lacked herbaceous vegetation as snows returned in the winter of 1980. The forest understory normally consists of herbs and shrub species adapted to cool, moist, dark conditions. These grow slowly; produce few, poorly dispersed seeds; and are intolerant of high-light or high-temperature conditions. Any such understory plants that survived the adverse impact of the blast and ash layers were thus confronted with an inimical environment.

Recovery in these blowdown areas will require invasion by aggressive species from the surrounding clear-cuts. As succession proceeds, conditions will gradually alter in favor of species adapted to the forest. A major prediction to be tested during the 1981 growing season is that within the blowdown area, pioneer species from clear-cuts will make up the bulk of new growth in the once forested parts. However, since the flattened trees create microsites favorable to the survival and regeneration of some understory vegetation, the next forest generation will be fostered by the slowly decomposing remains of dead trees.

The potential juxtaposition of plants having markedly different ecological strategies offers opportunities to test some ecological theories. Prevailing opinion would predict, for example, that in open microsites, pioneer species should outcompete the forest species, whereas in protected sites, the reverse should happen. As conditions improve, overall dominance should rest with forest species.

The region of tree blowdown and its surrounding ring of moribund trees presents the U.S. Forest Service with difficult management options. Standing dead and downed trees ameliorate the microclimate of the substrate, retard erosion, and foster natural succession. Trees blown into stream channels reduce erosion and siltation and promote the recovery of streamside vegetation and fauna. Furthermore, there is a widespread desire to preserve much of this region for interpretive, recreational, and scientific purposes. The Forest Service, which manages most of the affected land, must reconcile these factors with the value of downed timber and the danger of fire or of beetle infestations in Douglas fir, starting in moribund vegetation and moving into healthy, economically valuable forests. Salvage removal of downed timber is beginning, although not in areas designated for detailed study by the Forest Service Special Planning Team.

Flood plains are intrinsically unstable habitats, and those in the area affected by the May 18 eruption will recover more slowly than either the ash or blowdown zones. The mudflows, which swept the lower thirty-two miles of the North Fork of the Toutle River, fifteen miles of the Muddy River, and many smaller streams, removed most of the vegetation in their path before settling into unstable masses. Erosion rates will be high, and successful seed invasion will be limited for many years. Last July I observed cottonwood

Douglas C. Anderson



In many places, trees that withstood the blast were scorched by heat and noxious gases and covered with ash. Where this occurred, the mountain shows a line between brown, dead trees and green, living ones.

(*Populus trichocarpa*) seedlings colonizing the lower North Fork of the Toutle. Because they float through the air, cottonwood seeds were among the few seeds available shortly after the May eruption. Unfortunately, subsequent erosion from minor summer rains washed these seedlings away. Bob Zasoski of the University of Washington has estimated that more than ten years will pass before the first trees are established on these mudflows and more than a century before a more or less normal forest can develop.

While mudflows devastated the lower river valleys, a huge debris flow —a turbulent, water-driven, hot mass of rocks, boulders, and uprooted trees —ravaged the upper valley of the Toutle's North Fork. A few plants miraculously survived the vast jumble, and an occasional fireweed or bracken fern rhizome sprouted, but recovery on this debris flow will depend primarily on seeds invading from less damaged areas.

Comparisons between the broad debris flow on the North Fork of the Toutle River and the much narrower mudflow, close to intact vegetation, on the South Fork will provide a test of the hypothesis that the recovery rate on a site from which vegetation has been totally obliterated depends on the proximity to a pool of colonists. According to this hypothesis, recovery should proceed much more rapidly on the South Fork than on the North Fork.

Experimental manipulations of plots established on the debris flows during the next several years may also help answer some general questions about succession. Is there a definitive sequence to the recovery pattern or do chance and local seed availability dominate the process? Are the activities of specific colonizing plant species required to facilitate the subsequent success of other species? One way to test such hypotheses is by determining whether, after a number of years, plots



John Marshall

from which the first colonists are periodically removed differ from control plots. Another question of interest is whether succession tends to converge toward a single community type or whether initial site differences persist indefinitely. This question may be answered by comparing the initial degree of vegetation heterogeneity with that found five or ten years later. Significantly reduced variety would imply that convergence is indeed occurring.

Several slower and less publicized mudflows were driven by glaciers melting on the east, south, and west slopes of Mount St. Helens. Last September, I visited the upper portion of the six-mile-long Pine Creek mudflow, which was propelled by the now nearly defunct Shoestring Glacier on the southeast flank of the volcano. Although the preeruption vegetation in this location is not known, the area still reveals interesting aspects of vegetation recovery. The heat and toxic fumes of the main eruption killed the sparse lodgepole pine (*Pinus contorta*) and subalpine fir (*Abies lasiocarpa*) scattered on the high ridges above Pine Creek. The subsequent mudflow destroyed creek vegetation but it merely buried the snow-covered dormant ground cover of the ridge. Initially there was no vegetation on the mudflow, which varied in thickness from a few inches near the treeline to more than five feet at its upper end. The Cascade aster (*Aster ledophyllus*) was the first plant to emerge through this mud. Other herbs, including the broad lupine (*Lupinus latifolius*) and Newberry's knotweed (*Polygonum newberryi*), did not emerge until light rains created small erosion channels along which these plants were confined. Where mud was more than about a food deep, no vegetation emerged in 1980.

Since mud seals the soil and can limit oxygen exchange, buried vegetation may be suppressed through the inhibition of root respiration. An alternative mechanism, however, may operate on mudflows and in areas of heavy ash deposition. Both mud and ash insulate the soil and create a light barrier, two characteristics of a snowpack. Many plant species here and elsewhere may be fooled into "thinking" that winter continues. If this is so, as the 1980/81 winter snowpack melts and further erosion cleanses the mountain, surviving vegetation will emerge, having missed a growing season but otherwise unscathed.

North of Pine Creek lies Abraham Plains, a site that supported only limited vegetation prior to the May 1980 eruption. After the initial eruption, pyroclastic and hot-ash flows melted snowfields on the mountain's northeastern flank. The resultant mudflows covered or removed all vegetation on these plains. Revegetation in this area, unlike Pine Creek, will thus depend entirely on seed immigration.

The differences between recovery due completely to immigration and that abetted by residual vegetation will be documented in permanently marked plots at Abraham Plains and Pine Creek. Questions about succession under stressful conditions will be addressed. Do survivors and immigrants belong to the same species? Or, as in the case of Abraham Plains, is the habitat so severe that pioneers are the only species capable of survival? Are differences in species composition due to dispersal failures or simply to the absent species' inability to grow in unaltered mudflow material? Answers to such questions can be applied to the future reclamation of derelict



Soon after the eruption, herbaceous vegetation began returning to recent clear-cuts within the blast zone. The pink flowers of fireweed, a colonizing species of disturbed areas, were a common sight.

James A. MacMahon

In what was once a large meadow covered with huckleberry bushes, a lone spotted frog, right, rests next to a dying bush. To support this amphibian, the meadow must still have some permanent water source.



Mammals, birds, and insects have left records of their wanderings in the ash and mud, below. Where the crust is hard, the tracks of large animals provide traps for seeds and suitable sites for germination.



John Marshall

lands in volcanic regions of the Pacific Northwest.

Further insight into recovery mechanisms will come from observations of revegetation in sites on the periphery of the directed blast. The ridges and glacial valleys in these areas escaped the debris flow and pyroclastic activity. On ridges above the South Fork of the Toutle River, for example, the few lodgepole pines at timberline were killed by the scorching blast, but the lush herbaceous vegetation that normally dominates these ridges, including the yellow penstemon (*Penstemon confertus*) and the broadleaf lupine, returned with no apparent ill effects. On the other hand, the glacial valleys below the ridges, scorched by the directed blast or scoured by mudflows resulting from melting glaciers, lost most of their vegetation. Normally, these valleys support plants different from those on the more exposed ridges, but ridge vegetation is now the most likely source of seeds for the newly exposed terrain. Mountain glaciers such as the ones that formed these valleys ordinarily retreat slowly enough for valley vegetation to keep pace. When Mount St. Helens erupted, however, the rapid melting of the glaciers not only exposed large areas for the first time in more than a century but also washed away most vegetation below the glacier. Thus, in the absence of species specifically adapted to the valleys, ridge species may expand their habitat and create novel assemblages in the valleys.



Mount St. Helens is so young and its environment so harsh that even under normal conditions only the more generalized and stress-tolerant plants can survive. All plants common to the upper slopes display adaptation to unstable or chronically disturbed environments: deep taproots, buried growing points, large storage reserves, and good dispersal mechanisms. Therefore, although ridge-dwelling plants may under normal circumstances be competitively inferior to valley dwellers, they may be physiologically capable of surviving in the valleys. I plan to monitor the development of the upper glacier valley vegetation to see whether plant communities composed of ridge species do develop. Their existence in the valleys would be strong, although indirect, evidence for the importance of competition in stressful environments.

Of all the regions on the mountain, the most severely affected was the blast zone immediately north of the crater, including Spirit Lake. Every type of volcanic behavior displayed by the mountain has assailed this terrain. All life was seemingly obliterated. Trees were pulverized and soil vaporized. Yet, even here, life is returning. Forest recovery will be slow, but it will happen. Soil development will require the establishment of mushrooms, lichens, and pioneering herbs. Seed and spore sources are scarce but a few pockets of vegetation remain. A protected ridge beyond Abraham Plains, on the eastern edge of this area, for example, supports some silver firs and a few areas of herbaceous vegetation.

Higher terrestrial life may be scarce in the blast zone but dead organic matter is abundant, and such a resource is never unexploited for long. Here, where many humans died, where entire ecosystems ceased to exist in a matter of seconds, Dave Hosford of Central Washington State College has found a mushroom, *Autracobia melaloma,* growing from the ash, slowly decomposing organic matter found there, and beginning a terrestrial succession.

Most of the biological action in the blast zone, however, is taking place in lakes. Spirit Lake, once a pristine and clear body of water and now as appealing as a sewage lagoon, teems with microscopic life. Bob Wissmar of the University of Washington, who is conducting a systematic survey of the affected lakes, has pointed out that the water in Spirit Lake was totally removed by the force of the debris flow and replaced by a hot, muddy slurry of ash and debris. Thousands of trees, blown off the mountain and washed into the lake, have provided the basis of a new aquatic food chain on the clogged water surface. As the water cooled, blue-green algae and bacteria were the first active organisms, but decomposing anaerobic bacteria and protozoans now dominate the biota. The slowly dissolving organic matter has reduced the oxygen content of the lake and continues to release prodigious quantities of sulfur dioxide, the smell of which permeates the pyroclastic zone.

Many years will pass before Spirit Lake and other profoundly altered lakes return to a semblance of their preeruptive state. Recovery will be faster in smaller, higher lakes, which were more thoroughly protected by the snowpack. Higher lakes not hit by debris flows or mudflows were primarily affected by ash fallout and received only limited amounts of organic matter.

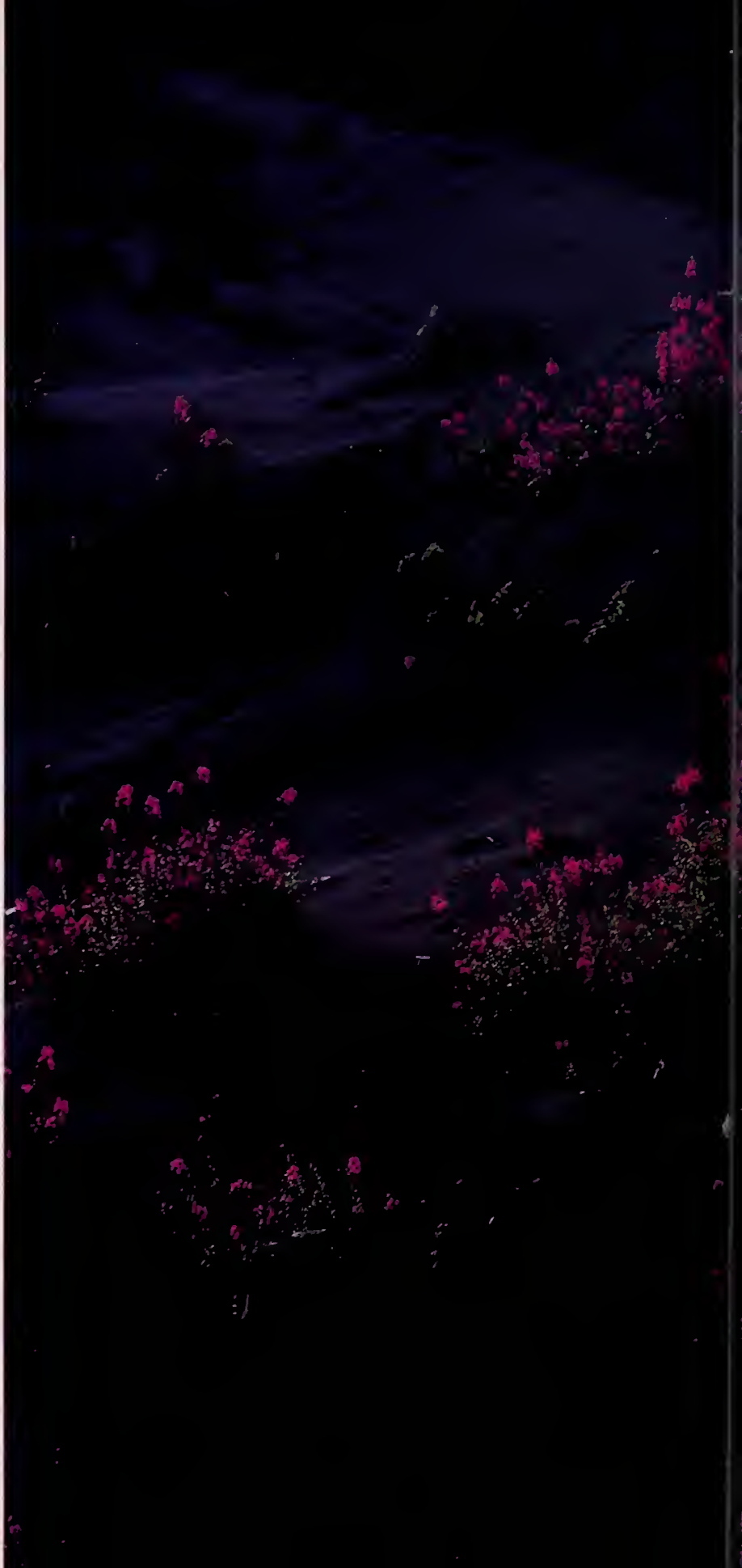
Ephemeral lakes, laden with organic debris and silt, pockmark the debris flow that settled into the North Fork of the Toutle River. These lakes were quite warm throughout last summer, and decomposition in them was rampant. A witch's brew of phenolic acids and tannins, smelling strongly of creosote and turpentine, is still draining from them. Tracks of elk, deer, and coyote are frequently encountered on the debris flow where little food is evident, suggesting that the animals may well be in search of water. Unfortunately, the quality of the water in ephemeral and permanent lakes is suspect. On one occasion, I found a

dead deer mouse, apparently poisoned by the tannin-blackened water in Castle Lake, which formed when the May eruption dammed Castle Creek.

As I write, the winter rains cleanse the forest of ash, and snow falls on the mountain slopes, restoring to Mount St. Helens a pristine appearance. The volcano will undoubtedly rumble for several years, however, and minor damage is likely to continue, particularly on the north slope. In such areas, the biological recovery clock may restart several times, providing future opportunities to observe several stages of succession simultaneously.

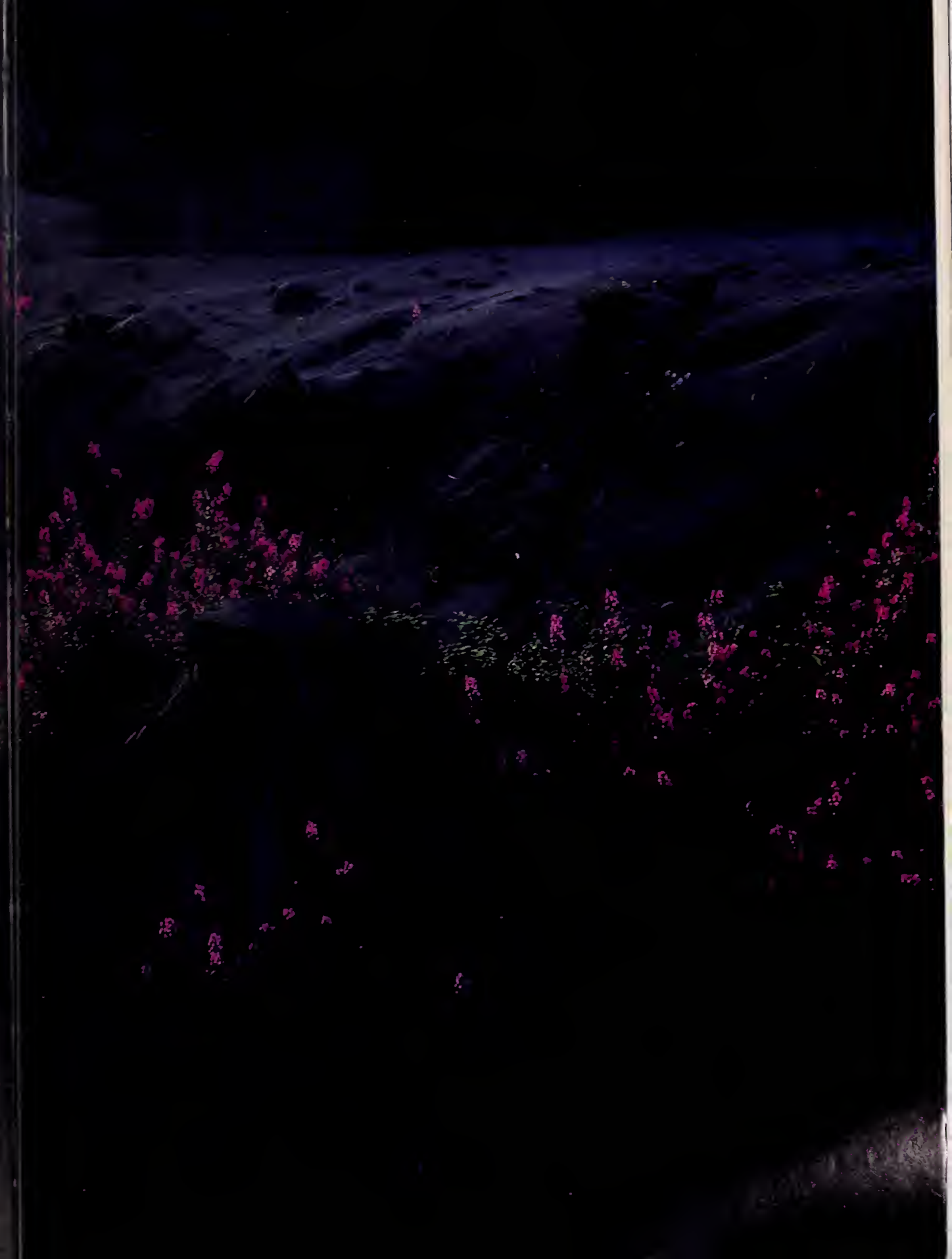
Recovery on the mountain will go on for many years. At first, physical changes will predominate: wind will remove the dust, mud will erode, glaciers may recover somewhat. Many lakes and streams should recover quickly, although the persistence of heavy sediment loads will probably retard the recovery of fish. In the higher forests, snow-protected small trees will form the next generation and provide a forested look to much of the blowdown area within fifteen to twenty-five years. Above timberline, as surviving vegetation emerges from beneath mudflows and ash, only subtle differences from preeruption conditions will be evident. Where high-elevation vegetation was destroyed, however, revegetation will be slow and dependent on long-distance dispersal.

Foresters, ecologists, soil scientists, limnologists, entomologists, and other biologists have coordinated their studies of the biological aftermath of the 1980 Mount St. Helens eruptions. In our efforts to understand how ecosystems recover from such fundamental disturbances, we build on the work of pioneers. What we learn may, in turn, help us develop judicious ways to cope with future natural catastrophes. No one wishes to experience further Cascade eruptions, but should they happen, we will be better prepared to encourage rapid and effective ecosystem recovery techniques. □



With the afternoon sun obscured behind a ridge, fireweed blossoms scatter their luminous message of life among the stumps of an earlier clear-cut operation four miles west of the peak of Mount St. Helens.

Ralph Perry

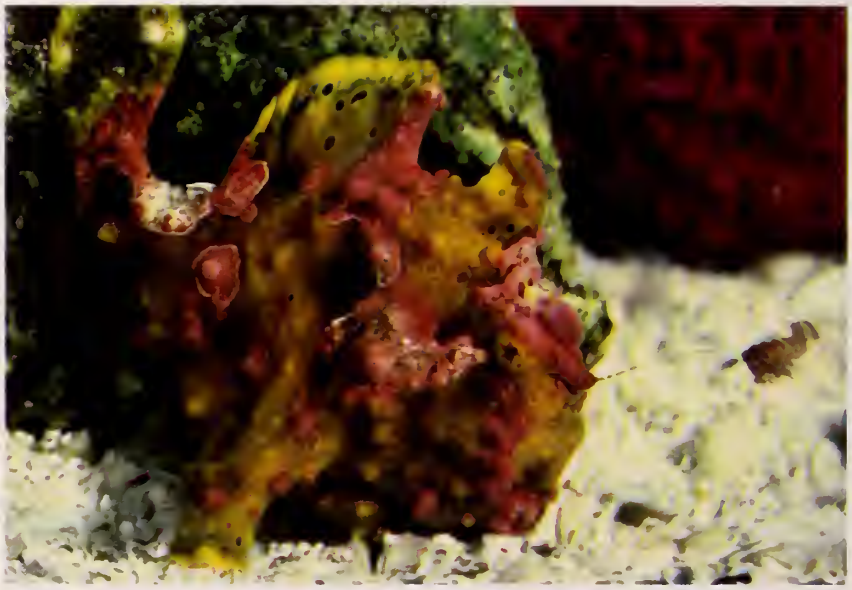


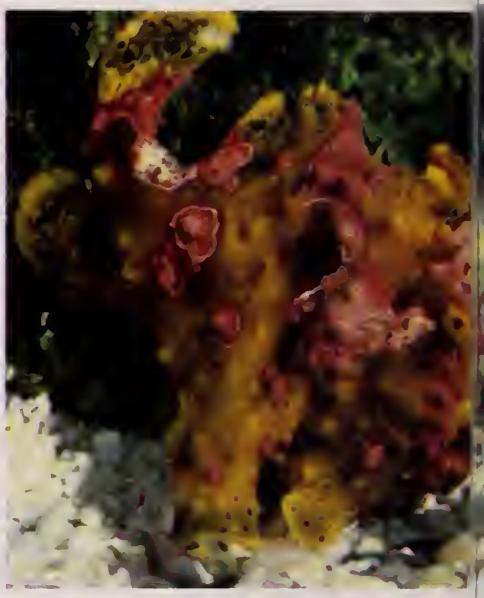

A world of wonder.
A world of value.
MEXICO
You'd have to crisscross the globe to find all the vacation riches waiting for you in Mexico. In one country, one visit... which we're sure will lead to many more... you'll experience an unforgettable panorama of sights and sensations. Ancient pyramids soaring above lush tropical jungles. The softest white sands melting into turquoise seas. Marketplaces alive with creativity. Fabulous museums. Elegant restaurants.
And our world of wonder goes on. A fascinating land made even more appealing as Mexico maintains its reputation as one of the great travel values. The extraordinary vacation. At a most ordinary price.
Coba... one of the many impressive archaeological zones on Mexico's magnificent Yucatan peninsula is awesome in size and scope. It means "opaque waters" and is located in the state of Quintano Roo... easily accessible from the resort paradises of Concun and Cozumel.


MEXICO
THE Amigo COUNTRY
Secretaría de Turismo • Consejo Nacional de Turismo
MEXICO See your ASTA Travel Agent
The Amigo Country
Mexican Government Tourism Office
9701 Wilshire Boulevard – Suite 1201
Beverly Hills, CA 90212
Please send me your newest brochure "Mexico, The Amigo Country."
Name
Address
City
State Zip
(Please print)
NH-5/81

Steady as a Rock, Fast as Lightning

Text and photographs by David B. Grobecker



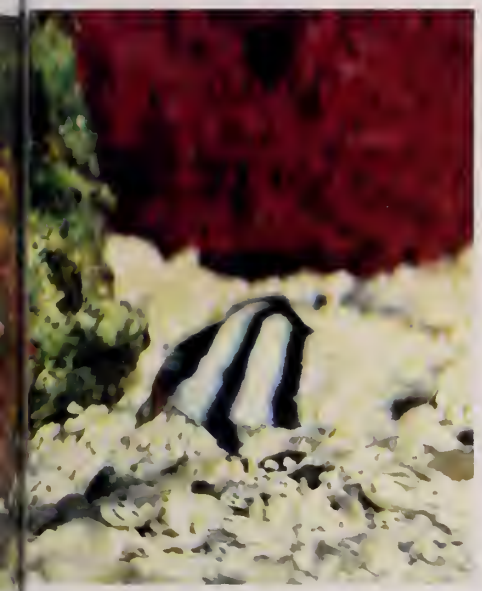


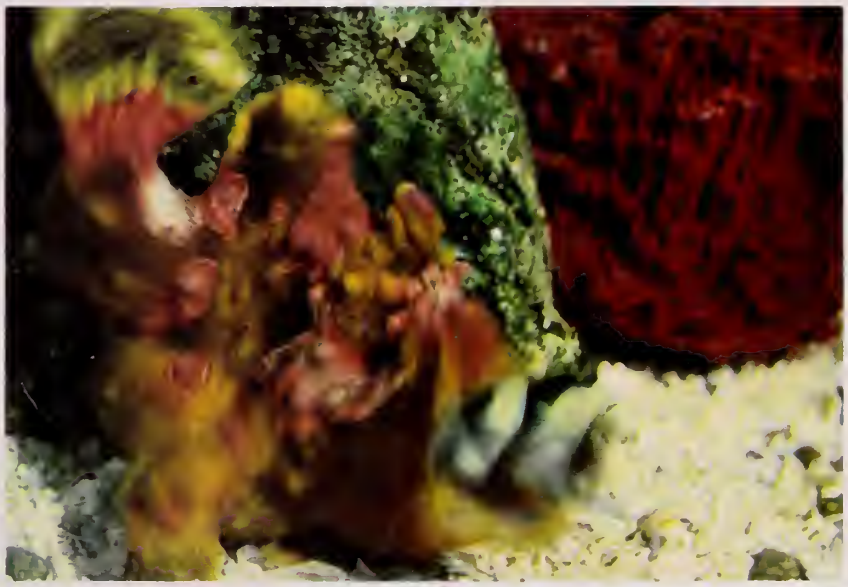
Swimming along a coral enclave in search of food, a small reef fish spots a prey item near a small coral-encrusted rock. The fish moves in for what seems an easy kill, but suddenly it mysteriously disappears. In a matter of milliseconds, this predator-turned-prey has been captured and consumed by a warty anglerfish (*Antennarius maculatus*). The small coral outcropping was in reality the cryptic anglerfish, and the apparent prey was part of a modified fin spine, which the five-inch angler dangled in front of its mouth as bait.

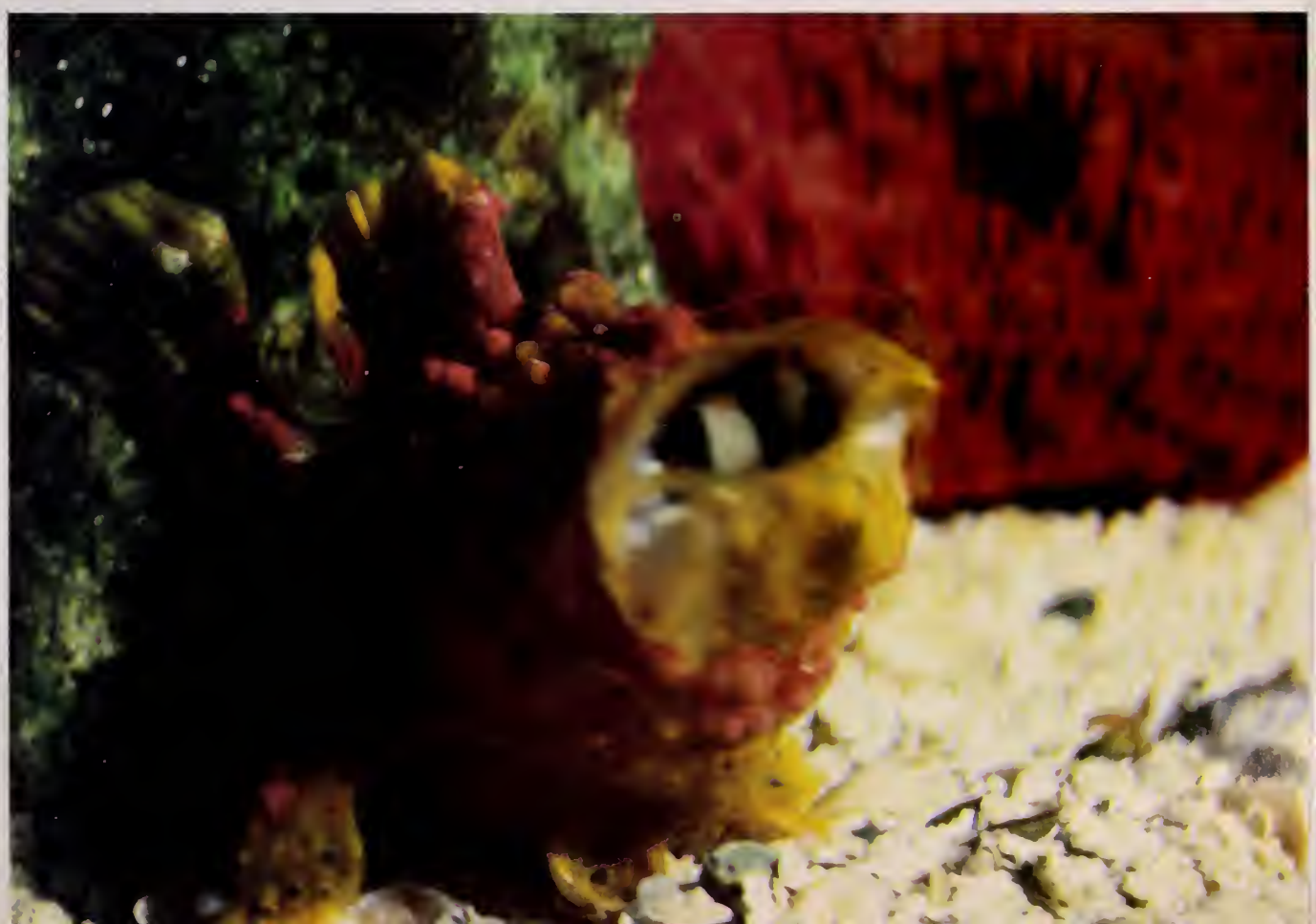
The warty anglerfish, so named because of the wartlike bumps that cover its body, inhabits the coral reefs of the Indo-Australian archipelago. The species belongs to the family Antennariidae, one of sixteen families of the order Lophiiformes, a curious assemblage of fishes characterized most strikingly by the anterior spine of their dorsal fin. This spine is placed on the end of the snout and modified to serve as a luring apparatus. At the tip of the flexible spine, or illicium, hangs a fleshy bait, or esca, which takes many different forms and mimics in appearance and movement such creatures as worms, shrimps, and even small fish. A shrimplike esca, for example, is maneuvered to simulate the quick, backward-darting motion of a swimming shrimp, while a fishlike esca is made to ripple as it is pulled through the water, mimicking the lateral undulations of a swimming fish. (If the "bait" is nipped off, a nearly exact replica rapidly regenerates. Growth is obvious within a few days, and the esca may be fully replaced within two weeks.)

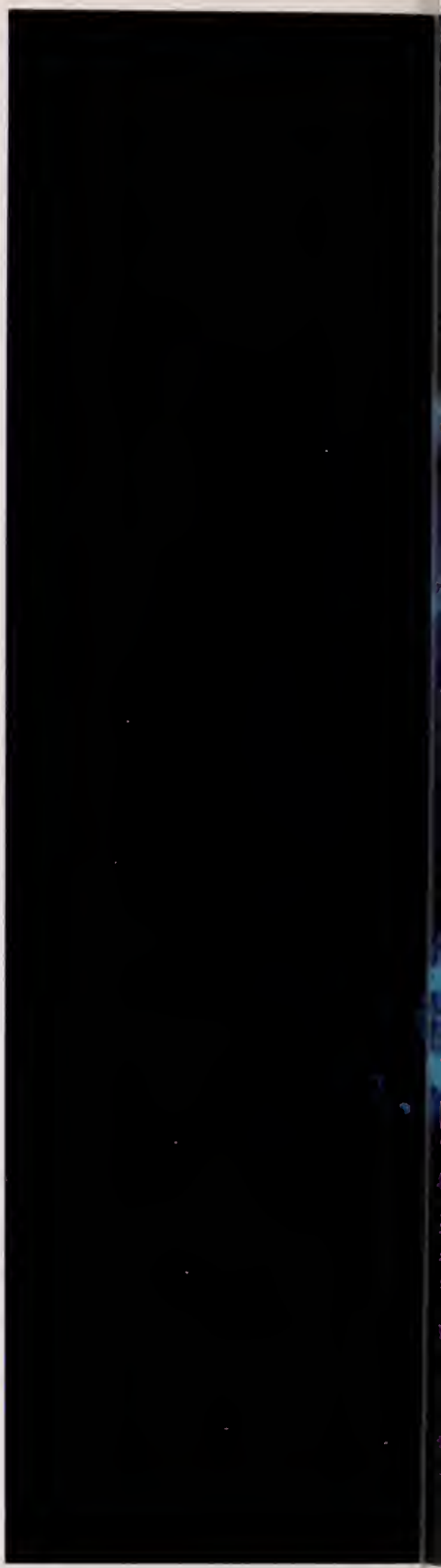
The feeding strategy of these piscivorous fish consists of wriggling the lure while maintaining the immobile, inert appearance of a sponge- or coralline-encrusted rock. When the anglerfish is not luring, muscles inside the esca contract and the illicium is laid back on top of the head in an inconspicuous position. Luring behavior is activated by visual and tactile stimulation. Once the prey is enticed within striking range, the angler suddenly expands its mouth cavity, creating a negative

A warty anglerfish, giving the appearance of an immobile sponge- or coralline-encrusted rock, wriggles a conspicuous lure at the end of a modified fin spine, left. A three-striped damselfish, Dascyllus aruanus, *dashes in and nips at the bait, center. With a sudden burst, the aggressive mimic engulfs the unsuspecting prey in one of the fastest feeding events ever recorded for vertebrates, below. In this rare case, the anglerfish engulfed its own bait and has just released it, bottom, keeping the damselfish securely inside its mouth.*









Anglerfish of the genus Antennarius *are able to engulf whole prey with body length considerably larger than their own, as demonstrated in this radiograph of an angler with a scorpionfish in its expandable stomach.*

pressure that sucks in both the victim and a large volume of water. This engulfment is so quick that all a human spectator sees is a blur. But by using high-speed cinematographic equipment to record and later slow the action down, I was able to observe closely the fish's unusual method of feeding.

A feeding warty anglerfish can expand its mouth to twelve times the volume of the mouth when closed. The speed at which it expands its mouth and engulfs its catch is amazingly rapid. Analysis of a film sequence shot at 1,000 frames per second revealed that the warty anglerfish was capable of engulfing prey in fewer than six milliseconds, making it one of the fastest-feeding vertebrates ever recorded.

The anglerfish is able to force an entire prey item directly into its stomach in only about twice as much time as it takes to engulf the prey. Clamping its modified opercular openings shut with its pectoral fins, the fish swallows the entire mouthful of water and prey. After the prey is safely in the stomach, the ingested water is forced out through the front of the mouth and the now unclamped opercular openings. Large prey items, sometimes larger than the anglerfish itself (see radiograph, right), are transported to the stomach in a conventional way, by the raking action of well-developed pharyngeal teeth.

When it comes to diet, the anglerfish is less than choosy. The warty anglerfish is mostly piscivorous but takes an occasional crustacean. The goosefish *Lophius americanus*, recorded to reach nearly four feet in length, is known to have eaten cormorants and herring gulls, while one dissected Sargasso angler (*Histrio histrio*) held sixteen young of its own species inside its huge, expandable stomach.

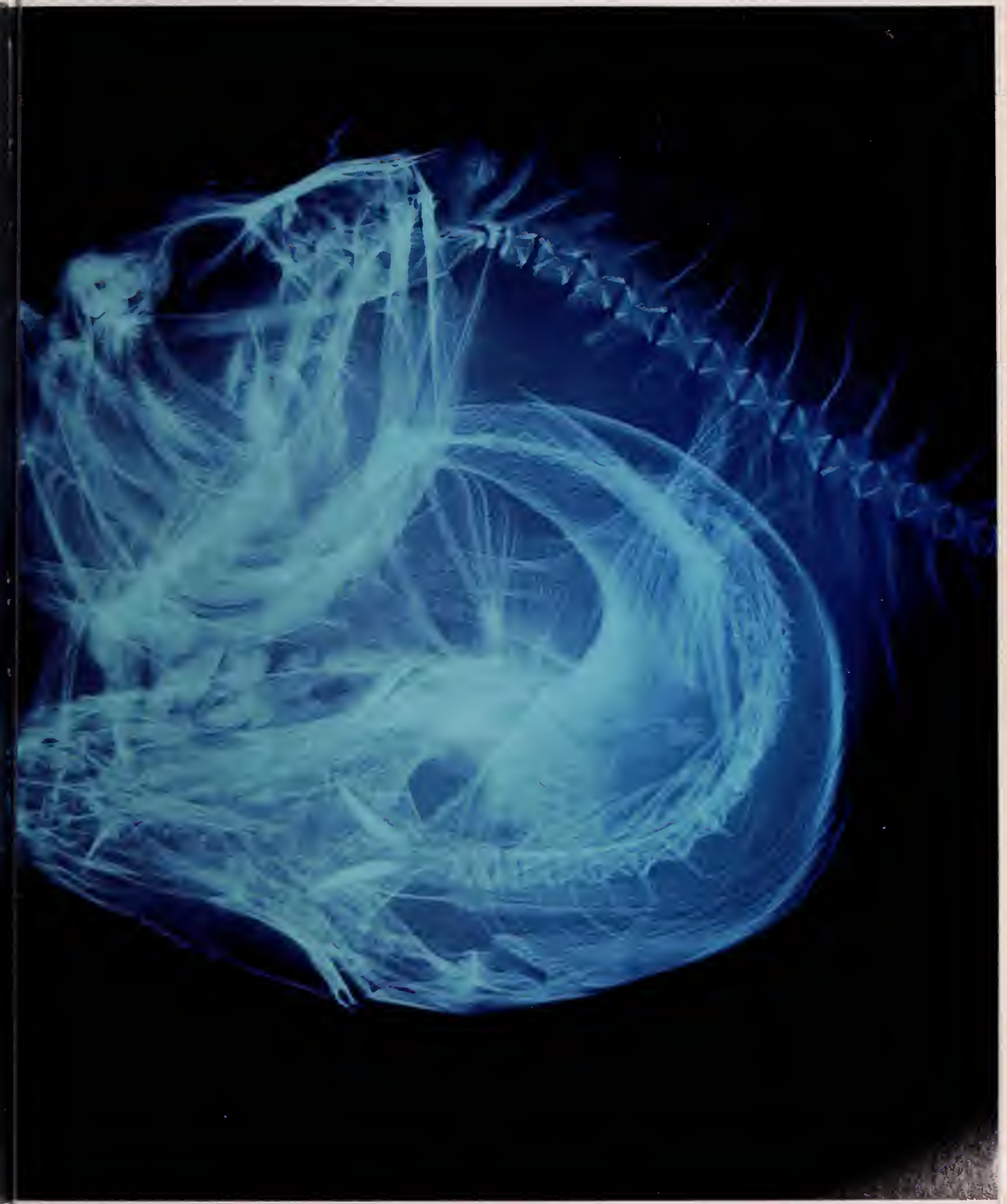
In 1837, the French naturalist Achille Valenciennes provided an intriguing, if anecdotal, discussion of the foraging behavior of an anglerfish:

> They have the ability to inflate their bodies like a balloon by gulping air or by filling their membranous stomachs with water . . . the position of the paired fins gives them the appearance of having four feet. . . . The tiny gill openings, represented only by a round aperture hidden in the axil of the pectoral-fin lobe, enable them to remain out of water for extended periods of time. This, in turn, enables them to crawl out over seaweed and mud. Thus, they pursue their prey. . . .

The ability to remain out of water is questionable, but these fish do use their armlike and leglike pectoral and pelvic fins to crawl, walk, and even gallop. They have also evolved another form of locomotion unusual for fish: jet propulsion. The anglerfish sucks water into its mouth and forces it out through the long, tubular opercular openings. Then, using its pectoral fins as planing devices and its tail as a rudder, the fish maneuvers about its reef habitat.

Warty anglerfish observed in aquariums aggressively defend their feeding sites against intruding anglerfish. A fish positions its body between its site and the invader, while at the same time engaging in elaborate display behavior. Spread fins, blushed colors, and a gaping mouth are accompanied by an intense shaking of the entire body. This intimidating display is usually enough to repel the unwelcome trespasser, and the anglerfish is once again free to turn into a rock.

The warty anglerfish uses great energy-saving tactics in its quest for food. The combined structural and behavioral adaptations, including the evolution of an ultrafast feeding mechanism, have played an important part in the success of this aggressive mimic. □





Good Dugong, Bad Dugong; Bad Turtle, Good Turtle

The sea provides, and Torres Strait Islanders have a highly discriminating sense of what in the marine larder is good to eat

by Bernard Nietschmann and Judith Nietschmann

Bernard Nietschmann



Jumping to add heft to his thrust, this Torres Strait Islander, is about to harpoon a fat dugong. He is aiming for the mid-back of the animal, and strength is needed to penetrate the inch-thick skin.

Paul K. Anderson

The persistence of a marine hunting society—based on large numbers of dugongs and green sea turtles—in the Torres Strait, between Australia and New Guinea, represents an intriguing case of survival. It involves isolation and acculturation, natural and cultural history, legislation and economics, and a set of adaptations by a seafaring people to two elsewhere-threatened marine animals.

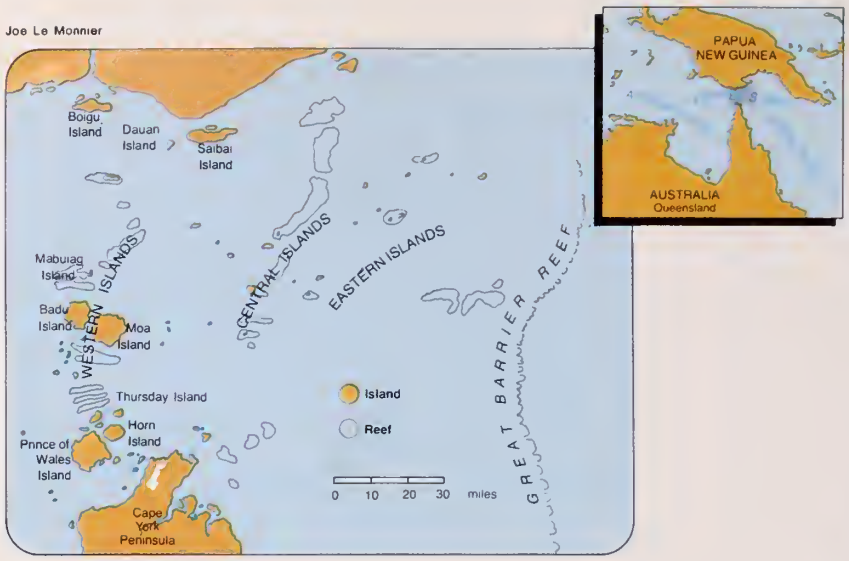
Dugongs and green turtles are unique in the sea because they are the only large, economically important, exclusively marine animals that graze on the world's underwater "grasslands"—the sea-grass communities. One link removed from the sun, these two herbivores convert the primary production of vast beds of sea grasses that flourish in shallow, clear tropical waters into abundant, flavorful, high-quality meat and fat. Held in high esteem by many seaside folk, in the past these animals have frequently been among the most sought after sources of subsistence. Many societies in the maritime tropics were once highly adapted to, and greatly dependent upon, these species. Today, however, they are rare, endangered, threatened, or gone over much of their former ranges. Probably the most important major refuge of these animals in the Indo-Pacific occurs along the marine fringes of northern Australia, including the Torres Strait.

The continuing presence of dugongs and green turtles has meant the survival of the Torres Strait Islanders' hunting activities and much of their culture. Most other tropical marine hunting societies have disappeared, overwhelmed by the spread of foreign colonization, cash market systems, and the loss or depletion of their faunal mainstays. These societies ceased to exist or were altered radically before much could be learned about their specialized cultural adaptations or about their knowledge of animal behavior, accumulated through generations of practical experience. Yet, the Torres Strait Islanders continue to follow old hunting patterns and traditional social customs even though they long have been in contact with outsiders and have adapted to many modern ways. They have adapted new influences in order to continue old life styles. The hunters are dependent on expensive gasoline, motors, and dinghies, but despite the economic costs and the hours at sea in cramped dinghies, they still follow tradition and freely give away meat.

For Torres Strait Islanders, hunting is more than a subsistence trait, a means to acquire meat, or an aberrant relic of past times; it is a way of life. Around marine hunting and the pursuit and capture of large herbivores revolves a complex system of logic and knowledge, environmental perception, social expectations and responsibilities, and the resilient roots of Islander myths and legends. The result is cultural adaptation to the coming of modern times to a once sequestered group of islands and people.

The Torres Strait area is Australia's "marine outback." Isolated and frequently cut off from the mainland by difficult environmental conditions and poor local transportation, it is a thinly populated and little developed region.

Joe Le Monnier



Some 4,500 Melanesian people inhabit seventeen of the myriad islands, thirteen of which are reserves; about 2,000 Islanders, and 1,000 other people of multiethnic backgrounds, live on minuscule Thursday Island, a nonreserve island and the region's only commercial and administrative center. The reserves are administered by Queensland's Department of Aboriginal and Islander Advancement (DAIA) and subject to a special set of state laws known as "the Act."

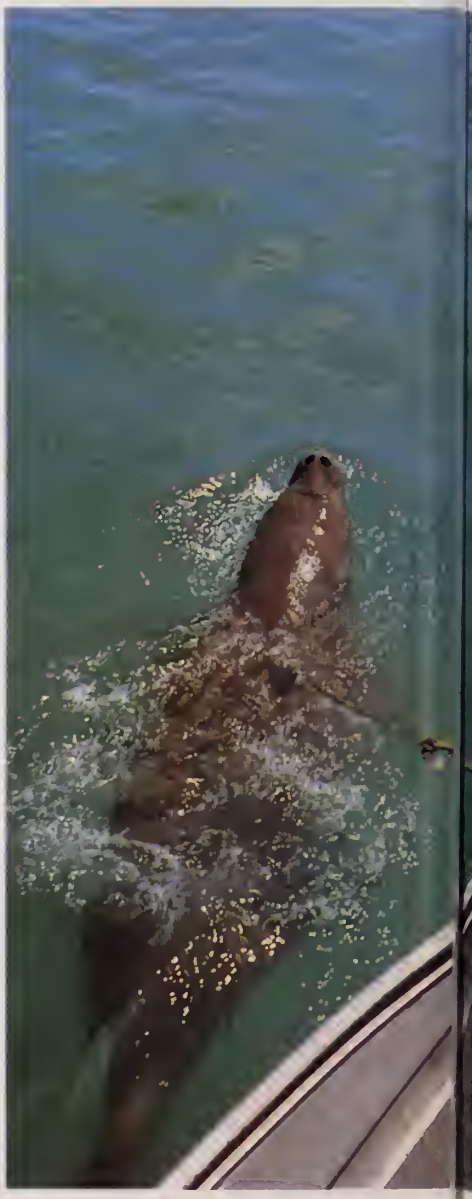
Within a span of little more than 100 years, this area has experienced many external influences: the introduction of Christianity and Mother Hubbard dresses brought by the London Missionary Society; several boom-and-bust economic cycles focused on pearl shell, trochus shell, and *bêche-de-mer* (sea cucumber), which introduced wage labor, cash-based economic exchanges, dependency on market goods, and South Sea Island males to supplement local labor; the influx of 6,000 Japanese pearl shell divers between the 1870s and 1940 (1,200 of whom never finished their six-year contracts, having died in the Torres Strait while pursuing their dangerous occupation); cursory bombing and the threat of invasion during World War II and the mobilization of Islanders into an army unit; and postwar increases in Commonwealth and Queensland State expenditures for new housing, medical care, and social benefits.

In the face of the kaleidoscope of introduced new ways and materials, the Islanders have maintained much from their past by recasting outside influences with Islander molds. All activities are dominated by kinship and social obligations. For example, even though traditional death ceremonies have been changed to accommodate introduced Christian rituals, the obligations of the living to prepare the way for the dead still follow traditional beliefs and kinship-based duties. Similarly, Islanders continue to hunt, not because they have to, but because they want to.

Queensland State legislation allows continued subsistence hunting of dugongs and sea turtles by Islanders (and Aborigines) living on reserves. The reserves represent both oppression and protection. The government controls the finances and most of the transportation and communication for the reserves. While some of the things an Islander can do are restricted because of the reserve legislation, Islanders can restrict outsiders from visiting the reserves. Islanders can travel between the reserves and to the mainland, but outsiders cannot go to the reserves without special permission. This must be obtained from the elected Islander chairmen and councils, which administer much of the internal affairs of each locally governed community and strictly limit and control the intrusion of non-Islanders. Thus, despite the presence of such conveniences as radios, tape recorders, hand-cranked sewing machines, outboard motors, tinned and sacked foods, and State and Commonwealth social benefits, the Torres Strait Islanders remain one of the foremost tropical marine hunting societies in the world.

Within the Torres Strait, dugongs and green turtles are concentrated in the waters surrounding the high, granitic Western Islands and to a lesser extent the low, coral Central Islands. Around these islands, the seas are shallower, the coral-rimmed reefs and sand shoals more abundant, and sea grasses more plentiful than around the volcanic Eastern Islands. The major hunting areas are concentrated over the numerous big reefs around Mabuiag, Moa, and Badu islands.

Dugongs and green turtles are dependent upon, and exert a considerable pressure on, beds of sea grasses and some algae. Pasturage and tides influence feeding time and place. During high tide the animals move to inshore areas and the higher, windward-side reef tops; during low tide they move to offshore, deeper water,



Exhausted and dying, a harpooned dugong is pulled to the boat, below. After a successful dugong hunt, carcasses are laid out on the beach, right. A dugong is butchered by the man who harpooned it, one of his mother's brothers, and select members of the hunting crew. Adult females are the most prized dugongs because they are fattest. Males are hunted when there are no females in the vicinity.

Barney Nietschmann, Jr.





Bernard Nietschmann

leeside reef zones. Daily grazing amounts are estimated to average 80 to 100 pounds for an adult dugong and 10 to 15 pounds for a large green turtle. Except for *Halophila*, found in sheltered intertidal island flats, the commonly grazed sea grasses, such as *Thalassia*, *Thallasodendron*, and *Cymodocea*, do not occur in dense single-species stands. Instead they are found mixed and scattered over large areas depending on depth, type of bottom, and exposure. Any one particular sea-grass bed cannot support long-term grazing; therefore, sea-grass availability, density, and recovery rate are the most important factors determining the presence and movements of dugongs and green turtles.

Seasonal and episodic fluxes in environmental conditions also significantly affect herbivore presence and movements and, accordingly, the timing and predictability of hunting. Tidal ranges and currents, water turbidity, and wind intensity and direction all influence temporal and spatial distributions of dugongs and green turtles. Extremely strong tidal streams (frequently six to seven knots and even more in narrow channels between reef sets), an eleven-foot tidal range, intermittent days and weeks of turbid and clear water, and two main seasons dominate marine conditions and herbivore habits.

Dugongs are highly sensitive to tidal fluctuations and changes in water clarity. Moving from place to place, they often swim with the flood and ebb tides. Some sea-grass beds are so shallow that they are dry at low tide; dugong feeding is thus limited to high-

tide periods. Since most hunting takes place in water two fathoms or less in depth, the large tidal range alternately opens and closes vast hunting areas. When strong winds coincide with fast tidal currents, the water becomes turbid and underwater visibility is often no more than three feet. Dugongs appear to prefer turbid water, which by making detection difficult offers them protection.

The southeast trade wind season, from about May through September, is the time of little rain, clear skies, gusting and heavy winds, and moderate to rough seas. Low tides and scattered animals make hunting during the day difficult. It is better at night when the high tides bring dugongs and green turtles to the reefs and island margins. A two-month-long period of calm weather follows, with light north winds, dead-calm sea, and good hunting conditions, both at night, when the herbivores can be spotted by trailing streams of bioluminescence, and during the day, when they can be easily seen in the clear waters. The rainy season lasts from December through April. This is the northwest monsoon season; frequent squalls, storms, and heavy winds often preclude distant hunting ventures. But there are many days of calm, and due to daytime high tides, hunting is generally much better than in the southeast trade wind season. The most favorable, but difficult, hunting conditions occur when a northwest storm lashes the reefs, driving large numbers of dugongs into leeside island shelter where they feed in the turbid water.

Dugongs live in loose social groupings whose size fluctuates periodically, depending on reproductive behavior, food supply, environmental conditions, local- and long-distance movements, and hunting pressure. Most dugongs we observed traveled in pairs—adult female and male or mother and calf—and in small groups of fewer than ten that included young, sexually mature, and old animals. Herds of more than twenty are rarely seen in the Torres Strait except when small groups gather together to shelter from a storm. At least some dugongs (called *malu dangal*, or "deepwater" dugong, by the Islanders) appear to travel long distances seasonally and may be migratory. Other dugongs seem to reside in large reef and island margin territories.

Even though dugongs are hunted year-round in the western Torres Strait, they are still numerous, probably as a result of protective legislation, possible recruitment of animals from even more isolated populations, frequent moves to reefs too distant for the hunters, and reduced hunting pressure due to post–World War II Islander emigration to the mainland (to seek employment and education). Around Hammond, Thursday, Moa, Badu, and Mabuiag islands, dugongs have been so abundant recently that they have clear-grazed extensive areas, causing Islanders to complain about the reduction of grass-habitat fish.

Of the four species of sea turtles found in the Torres Strait, only the green turtle is hunted with any regularity; the hawksbill, loggerhead, and the endemic Australian flatback are seldom hunted or eaten. Green turtles exhibit complex daily and seasonal movements that redistribute their numbers in and among foraging areas. They also make periodic migrations to nesting beaches—Bramble Cay at the northern edge of the Great Barrier Reef and Raine Island farther south. Nesting cycles overlap and probably occur at two-, three-, and four-year intervals; these may be influenced by ecological factors. Despite hunting pressures there are still large herds of green turtles in the Torres Strait, and this area, along with the rest of the waters off the Queensland coast, makes up what is perhaps the most important green turtle territory in the world.

In 1976, we began studying how the Islanders perceive and categorize the marine environment, and how their concepts correspond to the behavioral ecology of dugongs and sea turtles and influence hunting patterns. Local names for marine biota, features, places, and marine conditions were taught to us by the hunters during trips at sea. What began to emerge was a complex and detailed taxonomy. For miles around, the Islanders' underwater world is seen as clearly as if it were dry and readily open to view. There are names for large and small reefs, even for coral heads, dugong "scratching rocks," shoals and sand bars, shallow and deep areas, narrow, twisting passages or channels through reefs, sea-grass feeding areas, and various zones on the reefs where particular fish, crayfish, turtles, and dugongs can be found. The Islanders have a detailed, logically consistent system of knowledge and theory that integrates human and natural spheres into one ecological unit and permits them to make pragmatic hunting decisions in an oscillating marine environment.

A detailed and exacting classification system for marine features and biota is to be expected from a seafaring people. But it is in the understanding of tides and associated dugong and green turtle behavior that Torres Strait Islanders excel. According to the hunters, "Everything move on tide—fish, turtle, dugong. Everything. You have to know these things—these tides." We were taught more than eighty terms for different tides and tidal and water conditions. A few examples should give an idea of the complexity of their perception of tides and associated water condi-



Butchering is a complex process, as well as a highly social event. Lines are sliced into the dugong's hide to serve as cutting guides, above. At least forty-five different cuts of meat can be carved from a dugong. After the harpooner, his crew, and his mother's brothers receive their favorite pieces, other households in the village share what remains. This distribution of free meat brings prestige to the hunter. The bounty of the hunt is often cooked right on the beach, right.

tions: *kukiau gi iabagar* is a northwest season, daytime, big high tide; *mugi batainga ura* is an early morning, strong, clear-water, west to east tide; *kadigad* is a long, clear-water, slack tide between two neap tides; and *kutau usalai* is an afternoon, strong, dirty-water, west to east tide that occurs two to three days after new and full moons. There are good and bad tides for hunting turtle and dugong. Even if the villagers "feel to eat dugong," the hunters won't go out if the tidal conditions are wrong.

Of all the marine fauna, dugongs and green turtles are the most precisely described. There are terms for different ages, sexes, sizes, ranks, colors, social groupings, and taste qualities: a total of twenty-seven different terms to distinguish dugongs and thirteen for turtles. Taxonomy for dugongs corresponds closely to Islander categories for age, sex, and social rank (for example, female child, female teen-ager, single adult female, pregnant female, nursing mother, grandmother).

In dirty-water conditions, the hunters can often tell the size and sex of a dugong from its wake and position in a small or large herd. The most sought after and esteemed dugongs are the fatter females, particularly pregnant ones and those seen mating or feeding and traveling with a male. Wakes, heads, surfacing and diving postures, and herd position are difficult to discern at night. To distinguish age and sex, the Islanders often rely on the exhalation sounds dugongs make when they surface to breathe. Surfacing turtles and porpoises are often found on the reefs and add their own noises. When one of us, Bernard, first went with the hunters at night, turtle, porpoise, and dugong exhalations all sounded similar to him. After several hunts, he could tell the difference among them, but all dugongs continued to sound alike. Eventually, he began to volunteer guesses on whether a dugong was female or male. This was not a great breakthrough in perception as he had a 50–50 chance of being right. The hunters, however, seldom made a mistake. *Ipika dangal* ("female adult dugong") they'd decide and go after it. If they could not hear or approach a female closely enough, they would go for a male.



Bernard Nietschmann

A hunter cannot bring just any dugong or turtle back to the village. The animal must be fat, and it must have the right kind of fat. The Islanders have a very refined taste for meat and fat, which are inspected and savored to the extent that wines, cheeses, or cigars might be in another society. A *wati dangal* is a "bad dugong" and has a thin and "silky" layer of fat. It is considered almost inedible. The Islanders say that if you were to eat the meat of a *wati dangal*, it would have a bad taste and make your belly ache. Similarly, a *gatau waru* ("reef-dwelling green turtle") has bad fat—thin and black in color, not the thick and green fat of a really good turtle, or *mina kapu waru*. Both *wati dangal* and *gatau waru* are quite common around the islands and reefs. A hunter must be able to recognize their physical and behavioral characteristics so as not to harpoon one by mistake. The Islanders also say that the meat and fat from most male green turtles are poor tasting. When dugong and turtle meat are "proper fat," everyone is thankful. "When we eat good fat dugong we feel happy," one hunter told us.

Islander hunting strategies reflect their discriminating tastes. Small turtles and dugongs are not as fat as large ones and so are hunted infrequently. *Wati dangal* and *gatau waru* are generally left alone. Male green turtles are less fat than females and are seldom hunted. Huge turtles and dugongs are rarely sought because the small size of the dinghies makes it difficult to get back home with so much added weight. The hunting pressure focuses on the middle age-grades of *malu dangal*—the hardest to catch

—and on medium to large female green turtles.

Dugong and turtle hunting is a major activity for many men, and meat from these animals provides the most important and dependable source of protein to villagers in several island communities. Although all men consider themselves seamen, not all are hunters. A real hunter is called a *buai garka* (literally, "male family head"). In any dugong- or turtle-hunting party he is the leader, the harpooner, and the one who makes all the decisions. A *buai garka* is a respected person. "He knows how to hunt, how to find dugong, how to spear." It takes a long period of training and experience to become a good hunter. One has to master a complicated body of knowledge that includes the animals' behavior, the precise times and places to hunt, the difference between various types and qualities of animals, and the way to get close enough to a dugong or turtle to harpoon it.

Teen-agers start by going along as crew to help paddle and to pull harpooned animals alongside the dinghy. During the hunt, the *buai garka* will usually tell them about tides and dugong and turtle behavior. But to teach how to harpoon and to have luck is the role of one of a boy's mother's brothers (*audi*). When the novice is strong enough to handle a fourteen-foot harpoon, he is taken out for lessons. The first dugong that he catches is given to his *audi*. In addition, the boy's parents must provide a selection of gifts for the *audi* to choose from. The training and hunting relationship between a boy and his mother's brother conforms in structure and nature to traditional initiation rites that were discouraged many years ago by missionaries.

As much of the hunting takes place in turbid water conditions during the northwest season and at night during the southeast season, the hunters must rely on several clues to find their submerged prey: floating sea grass uprooted by dugongs as they feed; milky white sand and silt clouds in the water made by dugongs as they uproot the grasses; floating excreta; and wakes, swirls, and bubbles on the surface. The animals can be easily seen when they surface for air, but to get within harpoon range, the hunter must estimate the drift rate of his boat, anticipate the feeding interval time, and be able to distinguish the dark form of a submerged dugong from rocks, coral heads, and feeding turtles. He must also make sure that the animal is not a *wati dangal*, which has a thinner shape, more prominent backbone ridge, and rougher-appearing head than a good dugong. If he under- or over-estimates drift speed and direction or submerged feeding intervals, the dinghy will be too far away to use the harpoon. If he mistakenly harpoons a bad dugong, the entire effort has been a waste of time, and the noise from the struggling animal will frighten off other dugongs in the area.

Even with the proper training and experience, a hunter is far from assured that he and his crew will get a good dugong or turtle. Much depends on luck. Bad luck in hunting can be caused by people in the village



Green sea turtles are not as desirable to the hunters as dugongs, but more turtles are taken because they are easier to catch, above. Females are sought because the males are considered poor tasting. The meat from green sea turtles and dugongs provides the bulk of the protein intake for many villages in the Torres Strait. Hawksbill turtle eggs, right, provide a supplement to the Islanders' primary diet.

"talking bad" about the hunter, by wasting meat or allowing some to spoil, by being selfish and not giving enough meat to people in the village, by taking someone along as crew whose wife is pregnant, by having sexual intercourse the night before the hunt (this last belief is an old one, however, and not all hunters still practice sexual abstinence prior to a hunt). On the other hand, good luck can be encouraged by sprinkling salt on the harpoon line, by always giving meat to one's *audi* and asking him to help butcher, and by making a visit to the graveyard to ask ancestors for luck. Certain plants, ashes, and charms can also be used to attract dugongs and turtles, but these are personal secrets, and hunters do not readily talk about them.

Hunting is reliable, productive, and selective. During our research on Mabuiag Island, hunters returned with a turtle or dugong 75 percent of the time. Even though dugongs are the objects of most hunts, more green turtles are taken because of the comparative ease with which they can be captured. Dugongs, however, are more challenging, provide more meat and fat, and are considered better eating than green turtles. Hunting pressure from different island villages is predicated on population size and on such economic and social factors as availability of dinghies and motors, number and frequency of feasts (birthdays, baptisms, weddings, funerals, dinghy blessings), household purchasing power (for gasoline and oil), and environmental conditions (wind, sea, tide, and associated dugong and turtle movements). There is considerable variability in subsistence hunting from island to island.



Bernard Nietschmann

Butchering of dugongs and green turtles is a formalized social event. Women, children, and village men who did not participate in the hunt congregate on the beach to watch and comment loudly on the quality of the fat and the size of the animal while they await their portion. Three or four men will butcher a dugong or turtle: the man who harpooned the animal, one of his mother's brothers, and one or two members of the hunting crew. Young boys help by washing pieces of meat in the sea. A complicated system is followed for butchering a dugong. Lines are scratched into the thick hide to act as guides for cutting. The number, names, and placement of these cutting lines have not changed since the first ethnographic descriptions were made in the late nineteenth century. There are at least forty-five names for different cuts of dugong meat, and about thirty for turtle.

An adult dugong usually weighs from 500 to 750 pounds, 30 percent of which is considered edible; a green turtle generally yields 45 percent of its average weight of 250 to 350 pounds. Reducing these large animals to many small piles of specific pieces prior to distribution is physically demanding but socially enjoyable. It is a time for everyone to visit, joke, and share the story of the hunt.

Favorite pieces are given to the person who harpooned the animal, the members of the crew, the butchers, and the harpooner's mother's brothers. The rest of the meat is shared equally and freely among all households if there is enough. If the amount of meat is insufficient, the harpooner, in consultation with his *audi* and other elders, decides who will receive meat. Theoretically, households that were not given meat from a previous butchering are the first to receive. Waste is thrown into the sea where swarms of sharks quickly dispose of it. One man told us that it is an Island custom to feed the sharks with waste from a butchering: "We always give them something, turtle or dugong. They know we live from the sea just as they do."

People would eat more meat and fat if they could. If the annual Mabuiag dugong and turtle catch were divided equally among all the members of the community throughout the year, each person would receive about one

pound per day. If fishing and reef-foraging figures are included, then the total would be 1.2 pounds per person. However, rough weather, bad tides, dugong and green turtle movements, and scarce and costly gasoline limit hunting, and social relationships determine distribution. So the Islanders do not eat meat every day, but when they do, they eat large quantities. In one extreme instance, some 1,300 pounds of butchered dugong meat were distributed in Mabuiag to villagers and to visitors from Badu Island, giving an average of 10 pounds to each person. The meat was gone at the end of the second day of heavy eating.

It costs money to hunt. Outboard motors cost from $800 to $1,600, aluminum dinghies are $1,200 and more, and gasoline (as of September 1980) is $3.00 per gallon. The hunter and his household incur all these costs. Yet, in what is, in part, a monetary economy, they give away meat freely, as hunters always have. Exchange of fresh meat is essentially a social transaction, dependent on kinship ties and independent of cash value or production costs. Purchase of food is reserved for store products, with purchasing ability dependent on household composition and income. Traditional foods are exchanged between households; introduced foods are purchased and normally consumed within separate households. The most desired foods cannot be purchased—fresh meat and garden crops must be given. The capture of each dugong and green turtle, and the butchering and distribution of their meat, validate and maintain social relationships and roles, thereby insuring continuation of "proper Island custom" and solidarity.

Nutritionally, a hunting household is somewhat better off than a non-hunting household. Economically, it is often worse off because so much money is tied up in the dinghy, the motor, mechanical repairs, and gasoline. Socially, it is much better off. A successful hunter gains prestige because he provides the most esteemed items in Islander diet, gift exchange, and feasting. A single kill yields a meal for many households. But hunters don't go out to sea just for prestige. There may be pressure from relatives and members of their own household, especially the women, when people "feel to eat fat meat." A feast may be planned, and a dugong and a turtle should be served to make it a "number one" feast. And there are deeper and less immediate reasons for hunting. Staying around the village can be irksome, and hunting in small dinghies in rough seas for large animals is exciting and challenging. Hunters hunt despite the high costs because they receive personal and social satisfaction from their highly developed skills.

To be a hunter of dugong and green turtle is to participate in a social and perceptual affirmation of being an Islander. To hunt for meat maintains many of the old traditions and beliefs and gives meaning to existence for a people who have chosen not to interact directly in a large, developed, commercialized society and economy. □



An earth oven is used to cook green sea turtle meat, above. Islanders are extremely fond of meat, and the preparations for a feast, right, help to build anticipation for what is to come. The amount of meat consumed during a feast can be prodigious. At one celebrated bash on Mabuiag Island, 1,300 pounds of dugong meat was distributed to the villagers and to visitors from Badu Island. The largess, which averaged 10 pounds per person, was gone in two days.

Judith Nietschmann


SAXA
SALT
SAXA





A Martin House Is Not a Home

People erect elaborate accommodations for nesting purple martins to share. But the birds haven't learned to be good neighbors

by Erik J. Bitterbaum and Charles R. Brown

John James Audubon once remarked that he could always judge the quality of a roadside inn by the condition of the purple martin house erected on the inn's signboard. Good bird accommodations usually meant good people accommodations.

Audubon's observation illustrates the longstanding interest that people have had in the large, purplish swallows known as martins. The first nest boxes in this country were gourds hung by Indians to attract martins. In the 1800s, slaves in the South continued the practice of hanging out gourds. The assumption that martins will chase many species of hawks provided a utilitarian motive for such early martin houses: I offer you a nesting place; you protect my poultry. We feel, however, that the martin's propensity to chase birds of prey has been greatly exaggerated. They do, however, consume large amounts of insects.

Today, in neighborhoods across the eastern United States, martin houses of all makes and models can be found. Birdhouse manufacturers, in promoting their product, proclaim that the purple martin is America's favorite backyard bird. This claim may be more hype than reality, but the purple martin is probably the only North American bird to have its own newspaper. In the *Nature Society News*, published by a birdhouse-manufacturing firm in Griggsville, Illinois, martin fanciers report on their experiences with these birds.

The purple martin (*Progne subis*) is one of five species of the New World genus *Progne*. The other four species—the gray-breasted, Caribbean, southern, and brown-chested martins—are found almost exclusively in the American tropics.

Male purple martins, when about one and a half years old, attain a deep, glossy purple plumage over the entire body and are the only dark-bellied swallows of North America. Females, while having purple backs and crowns, are gray on the throat, breast, and belly. A first-year male resembles a female, except for a generally darker back and a lined patch of purple on its throat, breast, and belly.

Purple martins have a wide but patchy range throughout eastern North America. They also breed along the California coast, in the southwestern desert of the United States, and reportedly, in northern Mexico but are largely absent from the Rocky Mountains except for small, local montane populations. Because martin houses are not prevalent in the West, the

Occupying the topmost tier of a multilevel birdhouse, these purple martin nestlings are protected from the interference of neighboring juveniles by the roofline that separates the nest compartments.

Alfred A. Francesconi



birds there depend largely on abandoned woodpecker holes.

Purple martins migrate through Central America and the Caribbean to the Amazon River basin of Brazil, where they winter. Their annual arrival in the United States begins in late January in Florida and Louisiana and continues through May, farther north. Early arrival time may be related to finding a nesting cavity, a problem encountered by hole nesters that do not excavate their own cavities. Early arrival probably resulted from intraspecific competition for nesting sites, a behavior that evolved before humans provided martins with birdhouses. When the only nesting sites available were unused tree cavities, competition for sites was probably intense. If early arriving birds got the best or the only cavities, and as a result raised the most young, then arriving early could be selected for. A counterbalance to an increasingly early arrival in breeding areas is the probability that early birds will face periods of cold weather and starvation, and thus extremely early arrival could be selected against.

When purple martins nested largely in abandoned woodpecker holes (as the small western populations still do), they were probably mainly solitary nesters. This statement is supported by two kinds of evidence. First, before men and birdhouses came along, colonies of martins would have been possible only where woodpeckers had excavated a number of holes close together. However, most woodpeckers in the eastern United States that excavate cavities large enough for purple martins to use are solitary-nesting woodpeckers, and it is improbable that they bore and then abandon enough holes in any single tree to allow colonies of martins to form. Acorn woodpeckers (*Melanerpes formicivorous*) in the West are colonial and do dig many holes close together, but their extreme aggressiveness around their nesting sites prevents martin colonies from forming there.

Second, purple martins are not able to recognize their own young. This is strong evidence that they originally were solitary nesters. Biologists believe that whenever there is a chance that young of different parents may get mixed up, such as in dense colonies of birds, selection is intense for chick recognition so that an individual par-

Dana Downie

Howard Worthington, a farmer in Pleasantville, Iowa, who built this birdhouse for purple martins, left, about fifty years ago, reports that in the last few years he hasn't had many residents.
A skyscraper for purple martins, below, was constructed in the mid-1960s by the Jaycees of Griggsville, Illinois. The elaborateness of the structure, and the extravagant claim of mosquito consumption, are in keeping with the town's boosterism of these birds. The self-proclaimed "Purple Martin Capital of the World," Griggsville plays host to about as many martins as it has inhabitants—roughly 2,000.





Bill Thomas

ent does not assist the young of competing adults. As a result, chick recognition has evolved in most colonially breeding animals. Not being able to recognize their nestlings is a trait purple martins share with the related and solitary-nesting rough-winged swallow (*Stelgidopteryx ruficollis*).

What could have caused purple martins, at least in the eastern United States, to abandon their largely solitary life style and become a colonial backyard bird? This was probably brought about by the original clearing of much of the eastern forest, which eliminated many natural nesting sites, and the erection of birdhouses, both of which began in the early 1800s. This massive environmental perturbation essentially changed the nature of the purple martin's available nesting

Treat Davidson, Photo Researchers



sites in the southern and eastern United States. Multiroom birdhouses are especially conducive to coloniality because they contain many nesting sites in proximity. Single-room birdhouses are rarely built for martins, and when erected are quickly appropriated by other species; as a result, in many martin populations, solitary nesting seldom seems to occur.

Humans have provided these birds with many housing opportunities, and this has probably caused an overall increase in martin numbers. Yet all is not rosy for martins that nest colonially in birdhouses. For instance, spatial interference between neighboring purple martin pairs is common, owing to the parents' inability to recognize their young. Juvenile martins, when within one to four days of fledg-



Above: One purple martin fancier has expanded on the old Indian and slave practice of hanging gourds for the nesting birds. Right: Located near Tottenville, Staten Island, this complex reputedly houses the only active purple martin colony within the city limits of New York. The housing development for birds was set up by Howard Cleaves.

Anne Heimann

ing, often come out on the birdhouse porches. Since in many martin houses all rooms on a tier are connected by the same porch, the young may mix extensively and move between nearby compartments. Older nestlings cause much disturbance among the birds nesting on a tier, and when they try to enter nests containing eggs, they are often knocked off the porches by the occupants of these nests. These older nestlings sometimes successfully intrude into neighboring nests and usurp most of the food brought by parents of the younger nestlings. On one occasion, one of us observed a nearly grown nestling from one nest enter an adjacent room in which the young had just hatched. The pair in that room promptly abandoned their newly hatched young, which later died, and fed the intruder, which rapidly gained weight and remained in the nest for four days until it fledged. Young birds from adjacent-nesting pairs are most frequently involved in these disruptions, but all pairs that use rooms opening on a common porch are affected.

Besides providing nesting sites, people have also provided martins with some exotic nesting-site competitors. House sparrows and starlings were unwisely introduced into North America and have spread phenomenally from coast to coast. Both species use holes for nesting sites and appear to relish martin houses. Rarely is a martin house not also occupied by house sparrows, and starlings are a problem in some areas. These species fill martin-house rooms with bulky straw nests and sometimes actively chase purple martins away. Bluebirds and wrens also often usurp birdhouses erected for purple martins. Some people assist martins by destroying sparrow and starling nests as they are built, and others resort to shooting or trapping these interloping species.

The purple martin, regarded by some as the premier backyard dweller in North America, actually has been nesting in large colonies only a short time. People have provided martins with an abundance of new nesting sites; they have also provided pest species that compete for those nesting sites. The purple martin thus presents an opportunity for evolutionary study: over time, we can observe whether these birds adapt further to a colonial life style. □



Celestial Events

by Thomas D. Nicholson

The Moon The evening crescent moon in May should be seen by the 6th or 7th, passing beneath Pollux and Castor (the "twin" stars of Gemini) on the 8th. First-quarter moon is on the 10th, full moon on the 18th, and last-quarter (the morning moon) on the 26th. In June, the evening crescent will appear on the 5th in Cancer, move into Leo on the 6th, and pass very close to Regulus on the 7th. By June 9, the moon is at first-quarter, and will be full on June 17, in Sagittarius very near the winter solstice. The full moon of the 17th is the lowest full moon of the year, in the sense that it spends the least time and travels on the shortest arc in crossing the sky from rising to setting. Perigee moon (nearest the earth) occurs on May 4 and June 1; apogee (farthest from the earth) occurs on May 17 and June 13.

Stars and Planets Mercury, Venus, Jupiter, Saturn, Uranus (after May 18), Neptune (after June 14), and Pluto are in the evening sky; Mars, Uranus (until May 18), and Neptune (until June 14) are morning stars. Jupiter and Saturn are easily visible from dusk until they set after midnight. During the early evening, look high in the south; the brighter of the two is Jupiter (brighter than any other object these nights except the moon). Saturn is just slightly to Jupiter's left. Farther still to the left, the bright star is Spica, in Virgo. Watch carefully during May and June, and you will see Jupiter part slowly from Saturn as both move away from Spica. In June, Jupiter will begin closing the gap with Saturn as both planets, reversing their motion through the stars, move nearer to Spica. At the end of July, Jupiter will pass Saturn in the third and last of the "triple conjunction" series, which has been taking place since January.

The only other planet in relatively good position this month is Mercury, going through a favorable evening elongation. From mid-May until early June, Mercury will be low in the west about three-quarters of an hour past sundown, looking much like a very bright star below the twin stars of Gemini (Pollux and Castor). You may begin to see Venus, much brighter than Mercury, but lower, in the last week of May, setting in the sunset glow. If so, look above it for Mercury.

The sun moves from the constellation Aries into Taurus in mid-May, and Mercury, Venus, and Mars move along with it through these groups of stars, Mercury ending up in Gemini in late May and Venus in Gemini in early June. Jupiter and Saturn are in Virgo, Uranus is in Libra, Neptune in Ophiuchus, and Pluto near the border between Boötes and Virgo.

May 3–4: The Eta Aquarid meteor shower (up to twenty often bright meteors per hour) reaches maximum on the morning of the 4th.

May 8: The two bright stars above the crescent moon tonight are Pollux and Castor.

May 10–11: The first-quarter moon is near Regulus in Leo on the night of the 10th. It passes the star during the day on the 11th and appears east of it (to its left) that evening.

May 13–14: The moon, now in its waxing gibbous phase, passes Jupiter and Saturn tonight. It moves closest to Jupiter at about 10:00 P.M., EST, closest to Saturn at about 4:00 A.M. on the 14th. It will be readily visible as it moves between the two planets during the intervening hours.

May 15: The moon is near Spica, the bright star of Virgo, tonight, well to the left (east) of Jupiter and Saturn.

May 19: The bright star tonight near the moon, just one day past full, is Antares, in Scorpius.

May 26: Mercury is at maximum easterly elongation, its greatest distance to the left (east) of the sun. This places the planet in its best position to be seen as an evening star, since it remains above the horizon after sundown. Not all elongations are equally favorable for viewing the planet, but this is a good one since Mercury is still fairly high as the sun goes down, remaining above the horizon into the late twilight, when the western sky is dark enough to see it. Until the end of May, you can find the planet low in the west, below the stars Pollux and Castor.

May 28: Jupiter ends its retrograde motion and resumes its direct (easterly) movement among the stars. It now begins to move back toward Saturn, having last passed that planet in February.

June 3: The new crescent moon may be too slim and dim to see tonight, but look carefully in the west about half an hour after sundown. If you can find Venus, look below it, and the crescent should be there.

June 5: Saturn is stationary among the stars today, joining Jupiter in resuming its normal easterly motion (to the left, relative to the stars around it). In another week or so, Jupiter and Saturn will be noticeably moving closer to Spica (the bright star to their left).

June 9: Mercury is stationary and begins to move westerly (retrograde). It is in conjunction with Venus today.

June 9–10: The moon moves past Jupiter and Saturn during the morning of the 10th. From one night to the next, it will shift from the right to the left of the two planets.

Imported by the Paddington Corporation, New York, N.Y. 34 Proof © 1980



BAILEYS.
THE ORIGINAL IRISH CREAM LIQUEUR.

THE CREAM IS REAL. THE WHISKEY IS REAL.
ONLY THE TASTE IS MAGIC!



Kublai Khan

The Granger Collection

The Earliest Traces of a Conservation Conscience

The preservation of natural resources proves to be an ancient concept

by Robert M. Alison

Twenty-six years after my coronation, I declared that the following animals were not to be killed: parrots, mynas, the aruna, ruddy geese, wild geese, the nandimukha, cranes, bats, queen ants, terrapins, boneless fish [prawns] . . . tortoises and porcupines, squirrels, twelve-antler stags . . . household animals and vermin, rhinoceroses, white pigeons, domestic pigeons and all quadrupeds which are not useful or edible. . . . Forests must not be burned.

Asoka, emperor of India, 274–232 B.C.

A great many North Americans would probably be surprised to learn that the conservation of natural resources is a subject that has plagued almost every civilization that has ever existed. The earliest attempts to combat the sometimes overly exuberant use of resources by humans date to at least the Egyptian period. Of course, certain problems have been specific to particular societies, and thus remedial actions, in the form of laws, have varied widely in degree and target. Nonetheless, examination of the legal prohibitions set forth by leaders of the more than twenty civilizations that have appeared on the face of this planet, some of which have long since vanished, reveals consistent attempts by lawmakers to control the rates of natural resource consumption and environmental degradation.

Some of the earliest recorded instances were no more than crudely worded statements of penalties to be imposed in the event that a designated marshland was destroyed or that trees in a certain area were cut down by unauthorized individuals. With increasing technological advancement came ever more fantastic embellishments, both in wording and sphere of effect.

A few themes have consistently dominated the attention of conservationists throughout the millenniums. Notable among these has been a more or less universal infatuation with the concept of wilderness preserves—land set aside by a government for the perpetuation of its resident flora and fauna. One of the first of these was constructed by Ikhnaton, king of Egypt, more than three thousand years ago. Others were established, on independent initiative, by the Assyrian kings, beginning with Tiglathpileser I, in the eleventh century B.C.; the Greek city-states from the period of Xenophon (ca. 360 B.C.) onward; the Indian rulers beginning with Asoka; the Chinese from the reign of Hsiao-hsuan (ca. 100 B.C.); the Romans from A.D. 23; the Mongol Kublai Khan; the Aztec Montezuma; the Inca Pachacuti, and many more.

Wildlife preservation, in the form of laws regulating the taking of wild animals, has been an equally persistent aspiration. The earliest relevant laws seem to have been spawned by the Middle Kingdom pharaohs, who issued the first hunting licenses in order to regulate the activities of waterfowl hunters in congested marshes. Restrictions on the hunting of animals were put into effect in each of the known civilizations, including many limitations that had the effect of affording wild animals better treatment than that enjoyed by human residents.

Protection of vegetation, particularly trees, has been another consistent endeavor. Indeed, the earliest law protecting trees was formulated about 1900 B.C. by the authors of the Sumero-Babylonian Lipit-Ishtar law code, which prescribed a penalty of "one-half mina of silver" for cutting down a tree.

Perhaps nowhere has the so-called environmental conscience, as a distinct component of the global conservation movement, been so deeply rooted as in England. Consequently, a perusal of the numerous English laws enacted over the centuries affords a unique opportunity to appreciate the natural progression of concern, including relative priorities, that has occurred there.

That is not to say that events in England have mirrored those elsewhere. But they reflect an unmistakable regularity of theme.

One of the most remarkably persistent features of the colorful and well-recorded history of England has been a steady, almost fanatic dedication to the principles of natural-resource conservation. Although the most determined advocates were those sovereigns who had special interests in the environment, virtually no English king or queen after Alfred (ca. A.D. 892) was able to resist creating at least one outstanding contribution to the conservation cause.

Owing to the successful Roman invasion of England in the first century A.D., a substantial influence of Roman law upon subsequent English law is evident to this day. Indeed, it was not until the reign of Ethelbert (ca. 600) that major deviation from Roman doctrine was generated. The earliest English conservation law of which any record remains was formulated by Ine (ca. 700), whose Wessex law code stipulated that forests could not be



Pheasant

The Bettmann Archive

burned, meting out penalties for any infraction and further prohibiting the cutting down of any tree "big enough to shelter thirty swine."

At the beginning of the seventh century, England's forests were dominant features of the landscape, with great woodlots such as those of Beverley, Dean, Morfe, Kinver, Wyre, Rockingham, Selwood, and Sherwood. Marshlands were also a common integrant, particularly those of Romney and Pevensy, as well as the entire Thames estuary itself. At that time, central England comprised an almost continuous tract of bogs and fens, traversed by many streams and studded with wooded islands. In the following two centuries, however, the population increased, and with that, resources began to be developed to the point where many marshes were drained and woodland areas were reduced in size. Rivers were diverted, dams constructed, and livestock permitted to pasture virtually anywhere. As more acreage came under the plow, the ranges of many species of wild flora and fauna were greatly reduced. Such was the situation that faced the Norman conquerors in 1066.

In this period, the word *forest* had a special legal meaning. It applied to certain wide districts scattered throughout the realm, within which the king established an exclusive right to hunt and to manage the habitat accordingly. A court judged violations of strict forest laws, handing down extremely cruel penalties. These laws were enforced by the chief forester, aided by a number of foresters and wardens, each of whom had authority in a specified bailiwick.

The conservation contributions of the first two Norman kings were vastly overshadowed by those of Henry II's "assize of the forest" (1184), which placed strict controls over the activities of commoners, mostly within the royal forest holdings; established protection for game animals; and regulated trapping. He also prohibited night hunting, an activity first condemned by the Greeks at the time of Xenophon.

Prior to the reign of Henry III, conservation had been almost exclusively a royal concern. In November 1217, however, that monarch produced the "charter of the forest," which for the first time forced owners of private forests to reforest large tracts of land that had been denuded for livestock pasturage: "Woods may not be sold nor wasted by them that hold them."

National Portrait Gallery, London



Edward IV

Whereas the Norman and Angevin kings of England legislated by means of charters and assizes, from the time of Edward I (1272–1307), English laws were created in the form of statutes—acts of Parliament. The last of the English charters was the Magna Charta (1215) signed by the beleaguered John I, which devoted two of its sixty-three sections to environment-related topics. Section 44 abolished the forest courts while section 47 provided for a reforestation program in all royal forests and along all river banks.

The first act on the subject of conservation, formulated during the time of Edward I, protected salmon "from the Nativity of Our Lady unto Saint Martin's Day." The same act also abolished the penalty of death or dismemberment for the killing of a deer.

Edward III established the first trapping season in 1337 by prohibiting the purchase of furs after the Feast of Saint Michael.

Under Richard II, the hunting of wild animals became restricted to certain classes of people, excluding all "manner of Artificer, Labourer, and other layman [of a specified land holding] . . . Priest, or other Clerk."

Henry VI generated two conservation statutes. In 1423, to protect the "Brood and Fry of Fish," he prohibited the setting of nets in the rivers of England. Four years later, concerned about the rapid deterioration of coastal marshes and sea banks, he enacted legislation to remedy the "Hurt that within short Time will happen."

Edward IV prohibited the private possession of swans by anyone whose lands were valued at less than five marks yearly, thus officially making that bird a symbol of aristocracy.

Beginning in 1495, Henry VII churned out a series of statutes prohibiting the capture or killing of "feasants and partridge" except under the authority of a license issued by the landowner; the taking of hawk or swan eggs from the wild; the possession of certain species of hawks; and the use of nets or other contrivances for capturing deer.

The inexhaustible Henry VIII was a prolific author of statutes relating to environmental protection and hunting. He was an avid hunter and naturalist, a fact that is reflected in the wording employed in several of his statutes. His first enactment prohibited the hunting of hares on snow-covered ground, since "Hare . . . which

Game is now decayed, and almost utterly destroyed, for that divers Persons in divers Parts of this Realm, by reason of the tracing in Snow, have killed and destroyed, and daily to kill and destroy the same Hares. . . ." Shortly thereafter, legislation was prepared that protected certain of the most notable of the Thames River marshes from flooding. In 1533, Henry established the first English waterfowl season. Entitled "An act to avoid the destroying of Wild-fowl," the legislation created a closed season from May 1 to August 31, violation of which would be penalized by one year's imprisonment. Waterfowl eggs were likewise protected from March 1 until June 30. Six years later, severe penalties were set forth for anyone who violated strict regulations relative to the taking or possession of any "Faucon, Goshawke, or Laneret," or their eggs.

Henry VIII hated crows and ravens. During his reign, unusually severe anticrow laws were created, specifying that all persons in England "shall hereafter do and cause to be done as much as in him . . . reasonably shall be or may be, to kill and utterly destroy all manner of Crows, Rookes and Chouges," establishing a generous bounty, and forming a committee whose task it would be to supervise the eradication program.

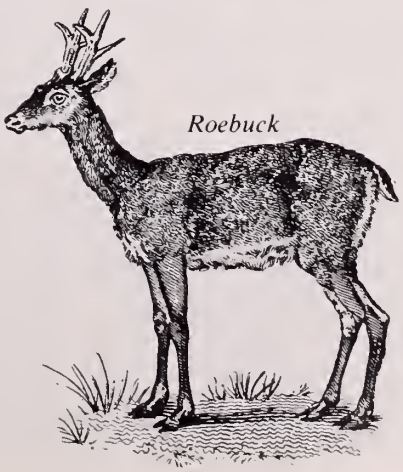
Edward VI and Elizabeth I devoted their energy to the common practice of poaching, an activity that had plagued landowners for centuries. Elizabeth went on to prohibit the use of nets in taking pheasants or partridge and to establish a closed season on these birds, because "the Game of Pheasants and Partridges is within these few Years in Manner utterly decayed and destroyed in all Parts of this Realm."

During the next 200 years, a steady stream of statutes came into being; virtually all of them addressed the increasingly stinging issue of wildlife management, or rather, game management. Statutes were created relative to falconry (James I); deer poaching (Charles II); "preservation of game," including the prohibition of sale (Anne); "deer stealers" and a new schedule of fines for game-related offenses (William and Mary); collection of fines levied for game offenses (George II); closed seasons for red grouse, partridge, pheasant, and black grouse in Scotland and the preservation of pigeons (George III).

National Portrait Gallery, London



Elizabeth I



Roebuck

The Bettmann Archive

National Portrait Gallery, London



Henry VIII



Partridge

The Bettmann Archive

In 1770, George III regulated shooting periods pertaining to game birds, restricting hunting hours to from one-half hour before sunrise to one-half hour after sunset—violators earned a penalty of six months imprisonment and a public whipping. The same king established a period of "six calendar months" during which any person who had bought or sold game could be prosecuted.

The problem of game poaching preoccupied George IV. The preamble to the statute that he formulated on the subject began: "Whereas the Practice of going out by night for the purpose of destroying game has very much increased of late years, and has in very many instances led to the commission of murder. . . ." It was decided that an appropriate penalty for violation would be three years hard labor or, alternatively, fourteen years in North America.

On October 5, 1831, William IV produced a statute that summarized and clarified the game legislation that had been devised during the previous five centuries, including novelties never before put into effect. In its forty-eight sections, the statute dealt with such things as hunting on Sundays, the use of poison, dealing in game, hunting licenses, court procedure, trespass in search of game, and ownership of game. In common with virtually all its predecessors, it did not mention habitat management, habitat preservation, or some of the other issues that in recent times have been grouped under the broad heading of conservation.

With Victoria came the zenith of conservation consciousness in England; in no other single reign were so many statutes on that subject created. From 1860 to 1892, eight distinct acts of Parliament dealing with game licenses, poaching prevention, sea bird preservation, wild bird protection (two acts), wildfowl protection, ground game, and hares were put into effect.

But as England stepped into the twentieth century, despite hundreds of statutes and ordinances, major components of the sphere of conservation remained unaddressed. Whereas there were laws relating to seventy-one species of birds (not including hawks), several species of mammals, and a few species of fish, not yet noticed was the plight of nongame animals, including most fish and all reptiles and amphibians. There were laws relating to trees, which were marketable,

but not to other vegetation, for which there was no market. Habitats, aquatic or otherwise, were destroyed with impunity. Nobody had given any thought whatsoever to environmental contamination. The question of humaneness in hunting, fishing, and trapping had not been considered. All these issues would crop up in the twentieth century.

The situation has always been the same. Caught up in immediate problems, societies could rarely afford the luxury of insight into future dilemmas and responded to crises in much the same manner as modern legislators. They reacted to obvious declines in animal populations by reducing the mortality of a target species, but not by providing places in the environment for the increased population to live and thrive. Since nobody had ever complained about plant rarity or floral extinction, this subject was ignored.

In the latter half of the twentieth century, most developed countries have accomplished a degree of conservation legislation appropriate to their degree of affluence. In the Western world, we have reached a level of human comfort hitherto unavailable to masses of people, and as a result, our lawmakers have been able to devote their time to such subjects as conservation, which might, at other times and in other places, have been left unaddressed.

Who knows the extent to which the conservation movement will influence future Western society? We have already seen that the presence of a tiny fish in an American river can halt the construction of a multimillion dollar power facility. In England, there is pressure for the enactment of a law requiring that the killing of shrimp and lobsters be made more humane. Environmental impact statements are becoming commonplace requirements.

Examination of the laws of the various civilizations that have existed to date reveals that conservation enthusiasm emerges early in the evolution of a particular society. But its refined incorporation into the actual behavior of citizens, in terms of positive effect, is restricted to the advanced stages of the society, since only then can it afford the luxury of concern.

Robert M. Alison, senior biologist for seven years with the Ontario Ministry of Natural Resources, is at present a free-lance writer.



The Bettmann Archive

National Portrait Gallery, London



Queen Victoria

Sri Lanka's
PERAHERA
Festival of the August Moon

Join a special tour to Asia's most spectacular celebration honoring the Sacred Tooth Relic of the Buddha. A hundred elephants, dancers, drummers, temple bells, the cracking of whips, blazing torches that light a myriad gems create the stunning pageantry of the Kandy Perahera.

You also tour the countryside to see ancient cities in the interior, the hill country, coastal villages, spice gardens, tea estates and craft centers. Extensions to the mountain valley of Kashmir and to the temple cities of South India are available.

For information please contact:

JOURNEYWORLD INT'L LTD.
155 EAST 55th ST NEW YORK, N Y 10022
TEL (212) 752-8308

BOOK HUNTING?
Virtually any book located—no matter how old or long out-of-print. Fiction, nonfiction. All authors, subjects. Name the book—we'll find it! (Title alone is sufficient.) Inquire, please. Write: Dept. 71
BOOKS-ON-FILE P.O. BOX 195
UNION CITY, NEW JERSEY 07087



OWL Stickers
This Sunny Yellow Owl, printed with your name & address or slogan, adds a little fun to letters, books, luggage, toys, promotions.....(shown half size)
Owl Shape...Self-Stick
100 for $6.50 or 200 for $9.20 ppd.
OWLS, Box 735-T, Acton, Mass. 01720



WHEN YOU WRITE TO NATURAL HISTORY

about a subscription renewal, billing, or any kind of adjustment, please include your present address label.

Moving? Please notify 6 weeks in advance. Send your present address label along with your new address to Natural History Membership Services, Box 4300, Bergenfield, NJ 07621

Name _____

New Address _____

City _____ State _____ ZIP _____
Please Print Attach Label

A Nonconforming Supernova

Cassiopeia A has not behaved the way supernovae of its type are supposed to

by Stephen P. Maran

Cassiopeia A, an expanding nebula from a seventeenth-century supernova explosion in the Cassiopeia constellation, is the youngest supernova remnant in our galaxy. Unlike other supernovae of historical times, however, it was not readily visible from the earth when it exploded, an unusual circumstance that has prompted much theorizing. There are two categories of supernovae: type I, produced by relatively low-mass stars; and type II, produced by high-mass stars. According to accepted ideas about type II supernovae, the category to which the Cas A explosion is assigned, either a neutron star or a black hole should have formed in the remnant. Neither, however, has been found, and some astronomers believe that the star that produced Cas A must have been totally disrupted by the explosion.

Cas A is a powerful radio source, a fact that caused its discovery in 1948 with a rather primitive radio telescope at Cambridge University in England. In 1951, more advanced equipment determined the precise location of the source, enabling astronomers in California to pinpoint it on photographs made with the 200-inch telescope at Mount Palomar. In the photographs of the location of the radio source, they found a very dim nebula composed of many small gaseous structures. These have since been classified into two groups termed knots and flocculi, respectively. Subsequent study also shows that the two groups of structures are moving out from the center of Cas A at different speeds, and that they also differ markedly in chemical composition. The knots move at the enormous speed of 3,700 miles per second; the flocculi move at only one-twentieth of that velocity. The knots are going so fast that they can actually be seen to move on telescopic photographs made just a few years apart. When the motions of the knots are traced backward on the photographs, you can deduce when and where the supernova explosion that produced them must have occurred. Estimates for the date range from A.D. 1657 to 1671. Spectra also show the chemical differences between the two groups. The flocculi have abnormally high ratios of nitrogen to hydrogen. By contrast, the spectra of the knots show no hydrogen or nitrogen, lack prominent emissions of iron, and reveal the presence of much oxygen.

If astronomers had reported seeing the Cas A supernova when it exploded, we would, of course, know its correct date, but they did not. Calculations based on the properties of other supernovae indicate that the Cas A event should have been easily visible. Estimates of its brightness differ, but range from an apparent magnitude of −2.5, brighter than any star of the night sky, to magnitude +2, the brightness of the North Star. At any magnitude in this range, the supernova would have been visible without difficulty to the unaided eye. Another supernova, called Tycho's star, was seen in the constellation Cassiopeia

in 1572, but no "new star" was found in that constellation during the period from 1657 to 1671 nor, indeed, has one been found at any time since.

That Cas A exploded without a "new star" being seen presents an enigma that has interested many scientists. According to one often discussed theory—proposed long ago by another scientist, but revived and revised recently by Roger Chevalier, an astrophysicist at Kitt Peak National Observatory in Tucson, Arizona—the exploding star was much smaller than usual for a type II supernova because it somehow shed its voluminous outer layer *before* the explosion occurred. This would make the supernova about 7 magnitudes dimmer than previously calculated, with an apparent magnitude of +4.5 at the brightest. A star of that magnitude is visible although not conspicuous to the naked eye and thus could have been overlooked.

A second explanation was advanced by Iosif Shklovsky, a world authority on supernovae at the Space Research Institute in Moscow. He believes (as I do) that the light from a type II supernova is not produced just by the explosion. Instead, the supernova luminosity may be largely powered by energy from a newborn pulsar formed when the star collapses and explodes. Thus, the size of the presupernova star would be less important in determining the supernova brightness than the properties of the new pulsar.

A pulsar is a highly magnetized, rapidly spinning neutron star, about

Better Than Jogging



NordicTrack

Jarless Total Body Cardiovascular Exerciser Duplicates X-C Skiing for the Best Motion in Fitness

This revolutionary new exerciser duplicates the smooth, rhythmic, total body motion of X-C skiing for the most effective cardiovascular exercise obtainable. Uniformly exercises more muscles than any other exercise device. Makes high heart rates easy to obtain and keeps more muscles in tone. Also highly effective for weight reduction.

Completely jarless natural motion does not cause joint and back problems as in jogging or running. Arm and leg resistances are separately adjustable for maximum effectiveness. The NordicTrack uses no motors and folds compactly for convenience. Used in homes, businesses, and institutions. Our customers include Xerox Corporation, US Army, Penn State U and the YMCA.

For more info, call or write

PSI 124 L Columbia ct. Chaska, MN 55318
toll free 1-800-328-5888, MN. 612-448-6987

QUESTARS ARE FOR LOVERS OF FINE INSTRUMENTS

Questar's inventor, who loved fine instruments, designed Questar for himself. First there was a set of optics so fine that no amount of money, time, or human effort could improve upon it. Second, believing that a telescope's use should not be a difficult physical chore, he made it easily portable and small enough to be used on a table, where an observer could sit in a relaxed position. Third, accessories were built in, with fingertip controls within easy reach. Fourth, the mechanical design permitted polar equatorial positioning in a moment and without the need of a separate tripod. Fifth, for versatility in the field of nature study he introduced the ability to focus as close as ten feet, which no other telescope in the world could do. Sixth, he made the design photovisual with the ability to record on film whatever these superior optics would present to the eye. And finally he achieved the rugged construction that eliminated the vibration and aggravating oscillations so familiar to those using long-tubed conventional telescopes.

Let us tell you more about Lawrence Braymer's remarkable invention based on an optical system by Maksutov, which was the first break-through in telescope design in 200 years. Send for our booklet in color, describing Questar, the world's finest, most versatile telescope. $2, please, for mailing costs.

© Questar Corporation 1979



QUESTAR

Box LF 60
New Hope, Pa.
18938
(215) 862-5277

Oriental Shou motif, deeply etched on a set of 6 double old fashioned glasses #111 $22 Members $19.80 Matching 2 qt. Pitcher #112 $25 Members $22.50

Long Life!



American Museum of Natural History
Museum Shop Dept. 228
P.O. Box 174
Scarsdale, N.Y. 10583

Please print
Name _____
Address _____
City _____ State _____ Zip _____

Item #	Qty.	Description	Price	Shipping/ handling	Total
111		Glass set of six		3.00 per set	
112		Pitcher		2.50 each	

Customer Inquiries: Call 212 799-8958

Most deliveries will be made by U.P.S. so please provide street address.

Order Total
N.Y. State Tax
Total Amount

Member Membership #_____ Non Member

I've enclosed check or M.O. in the amount of $_____ payable to American Museum of Natural History (NO C.O.D'S)

Charge To: Master Charge Visa American Express

Account #_____ Exp. Date_____

Signature (req. if using credit card) _____

international nature tours

Galapagos Islands/ Headwaters of the Amazon/Ecuador/ Peru/Patagonia/ Falkland Is./Kenya Tanzania/Rwanda Gorilla Safari/Costa Rica/Nepal/New Guinea

Expert Naturalist Guides
Very Small Groups

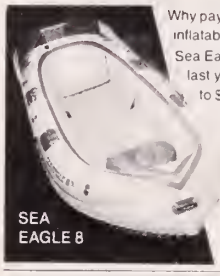


Write: **WILDERNESS TRAVEL*** 1760-NJ Solano Ave., Berkeley, CA 94707 (415) 524-5111

*formerly *So. American Wilderness Adventures*

SEA EAGLE

The Quality Alternative to High-Cost Inflatables



Why pay $600 or more for an inflatable boat?

Sea Eagles pack small, last years and cost $100 to $220. Canoes, dinghies and motormount boats. Write for **FREE** brochure

SEA EAGLE 8

Sea Eagle
Dept. NH-5
St. James, NY 11780
phone 516-724-8900

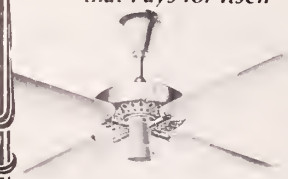
Free Dover Nature Catalog

200 attractive paperbacks from $1.25 to $5.00, formerly $10.00 to $500.00. Nature studies, ornithology, zoology, botany, nature identification aids, ecology geography, anthropology ethnology. By Audubon, Bent, Cruickshank, Sargent, Britton and Brown, others. 48-page catalog absolutely **FREE!** Write Dover Pubns., Dept. A10,180 Varick Street, New York, N.Y. 10014. *'America's most imaginative reprint publisher.'*—Time Magazine

BOOKS PUBLISHED

National book publisher can print your book for as little as 18c per copy (paperback, 100,000 copies). For further info write: Regal Press Inc., 4555 W. Lovers Lane, Dallas, Texas 75209 or call (214) 353-9913.

A DECORATING CLASSIC
that Pays for Itself



Save up to 25% on heating and cooling costs while enjoying the quiet efficiency of a Hunter ceiling fan, standard of excellence all over the world.

52" fan . . . $275 36" fan . . . $199

Send 50¢ for color brochure

The Ceiling Fan Gallery
8 Indian Neck Lane, Peconic, N.Y. 11958

50 percent more massive than the sun, yet no larger than fifteen miles in diameter. In the immediate aftermath of its birth, a pulsar may shed energy at a fantastic rate, sufficient to propel and illuminate the surrounding nebula of the supernova. From the fact that no bright star was seen when Cas A exploded, Shklovsky deduced that no pulsar formed. If this conclusion is correct, the possibility remains that a so-called bare neutron star—one lacking the high magnetic field and fast spin of a pulsar—was formed. In that case, the supernova *would* be dim, but the bare neutron star, starting with an initial surface temperature of millions of degrees Celsius and cooling very slowly over the centuries, would still be observable today as a compact X-ray source at the center of Cas A.

Since no compact X-ray source exists in Cas A, Shklovsky concluded that not even a bare neutron star was left from the supernova. This position was recently reinforced by an X-ray image of Cas A, made with unprecedented sensitivity by the *Einstein* satellite, which confirms that there is no hint of a compact X-ray source at the center of Cas A. This leaves two likely possibilities concerning the Cas A explosion: either the presupernova was totally disrupted or the core of the presupernova collapsed to form a black hole.

Since there is no sure way of directly observing a black hole, we have to resort to indirect evidence that may bear on the question of whether a black hole formed in the supernova. In particular, the chemical composition of the knots may be relevant.

Nuclear reactions inside a star convert the gas there, which consists mostly of hydrogen and helium, to successively heavier elements. By the time a massive star has reached the developmental stage of a type II supernova, its central core should consist mostly of iron. The high speeds of the outward-flying knots in Cas A indicate that they must be fragments of the exploded star. Thus, if the core was disrupted along with any overlying layers, the knots should contain notable amounts of iron. As mentioned previously, however, the spectra of the knots lack the strong emissions of iron that would then be expected. Because of this circumstance, Shklovsky decided that the core of the presupernova star did not shatter and that since it did not form a neutron star, it must have become a black hole. Although this argument seems logical, it has not been generally accepted by astronomers. Some, for example, believe that the composition of the knots can be accounted for by nuclear transmutations during the supernova explosion itself.

I don't know how bright the supernova would have been if a black hole had formed, as theorized by Shklovsky. However, Chevalier's proposal that the supernova explosion that produced Cas A was smaller than usual at least predicts the supernova might have been visible to the naked eye as a dim star.

An astronomer active at the time of the explosion and therefore in a position to record it was John Flamsteed, England's first astronomer royal. He systematically tabulated the stars visible to the naked eye during the latter part of the seventeenth century and issued a catalog of them. Even today, many stars continue to be known by their "Flamsteed numbers," as assigned in his catalog. On August 16, 1680, Flamsteed observed what he later described as a sixth-magnitude star that he named 3 Cassiopeiae. There is no indication that he believed the object to be at all different from the many other stars that he was surveying. By means of a sextant, he determined the angular separations of the object from each of two bright stars: Scheat, in the constellation Pegasus, and Algol, the famous Demon star in Perseus. From these measurements, he later calculated the position of 3 Cassiopeiae.

As far as is known, neither Flamsteed nor anyone else ever saw 3 Cassiopeiae again. There is no star at the position he posited, so at various times astronomy historians have concluded that Flamsteed's August 1680 observations were erroneous. But three scholars within the past two years have pointed out independently that Flamsteed's derived position for 3 Cassiopeiae is very near the deduced expansion center of the knots in Cas A, suggesting the possibility that the dim star he observed may have been the supernova. In that case, the supernova would have exploded in 1680 rather than in the deduced 1657 to 1671 period. This discrepancy is not surprising, given the uncertainties in measuring the motions of the Cas A knots. In addition, there is the possibility that the expansion has slowed down since the explosion occurred, which would lead us to deduce an

erroneously early date for the supernova.

An analysis by one of the three scholars mentioned above convinced him that 3 Cassiopeiae was in fact the supernova. Another of the three, however, a specialist on Cas A at the David Dunlap Observatory in Toronto, reached the opposite conclusion. He thinks there probably never was a 3 Cassiopeiae. Instead, he believes that Flamsteed goofed and measured the arc from Scheat to a fifth-magnitude star and mistakenly measured the arc from Algol to a different, seventh-magnitude star, which he confused with the fifth-magnitude object. Thus, in mistaking one star for another, Flamsteed would have derived his published position for 3 Cassiopeiae from the two sextant measurements. This second interpretation implies that Flamsteed in fact made a double blunder, confusing the two stars with each other despite their different brightnesses and different positions. Nevertheless, there is no way today to tell whether Flamsteed's 3 Cassiopeiae was the supernova or whether his measurements were incorrect.

Since the interpretation of Flamsteed's records is ambiguous, we can only rely on modern observations to investigate the nature of the exploding star. They give us some useful hints about how the star evolved before the explosion, but nothing definitive about the event itself. The astronomer who has done the most comprehensive job of putting the observational data together and explaining what they mean is Susan Lamb of the University of Illinois (Urbana-Champaign). An expert on the evolution of massive stars, Lamb has deduced that the Cas A presupernova underwent *two* intervals of heavy loss of mass before the explosion occurred. Her reasoning goes like this: The high speeds of the knot structures prove that they were ejected in the explosion itself, while the lower velocities of the flocculi structures indicate that they were shed at least 10,000 years before the explosion (a fact already known). But the strange composition of the flocculi, with their heavy ratio of nitrogen to hydrogen, means that they did not come from the surface of a normal star since no stars have been found with such a heavy nitrogen concentration. Computations show, however, that such concentrations do form unseen, deep inside massive stars in the young blue supergiant stage. As the supergiant converts hydrogen to helium in the nuclear furnace of its core, it increases the ratio of nitrogen to hydrogen simply by diminishing the latter. A powerful stellar wind, acting over many hundreds of thousands of years, can blow off most or all of the unburned hydrogen layer that surrounds the zone of enhanced nitrogen. (Winds of sufficient power have been observed in young blue supergiants by the *Copernicus* and *International Ultraviolet Explorer* satellites.) According to Lamb's theory, this occurred a very long time ago, giving the windblown unburned hydrogen layer time to disperse in space beyond the possibility of recognition. Then, only 10,000 or so years ago, as the aging star approached its end, the wind picked up again, blowing off the nitrogen-enhanced material to form the flocculi. Heavy winds of the kind required by Lamb's hypothesis have been found in older red supergiant stars. Finally, about 300 to 325 years ago, the theory goes, the by then much smaller star exploded, creating the knots of Cas A.

Lamb's theory is consistent with Chevalier's idea that the supernova was dim because the exploding star was unusually small. The theory also doesn't seem to contradict Shklovsky's deduction that a black hole formed, although Lamb told me that she believes the presupernova star was wholly disrupted. Can we at least conclude that either there is a black hole in Cas A or that no condensed object was left by the explosion? Even on this question, the jury is still out. The possibility exists that some neutron-star-like objects are formed of subatomic particles called quarks, thought by physicists to be the ultimate building blocks of matter. Such a tiny neutron-star-like object, or quark star, would cool more rapidly than a neutron star and would thus not show up in the *Einstein* satellite survey for small hot spots in Cas A.

Advances in observational technology may ultimately make it possible for astronomers to determine what, if anything, still lurks within Cas A. Nevertheless, we will never know with certainty whether anyone actually saw the supernova.

Stephen P. Maran is a senior staff scientist in the Laboratory for Astronomy and Solar Physics at NASA's Goddard Space Flight Center in Greenbelt, Maryland.



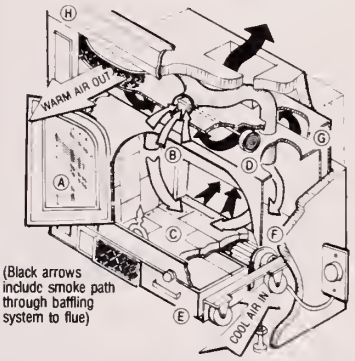
The Shelburne Fireplace-Stove

Its graceful design is timeless, its engineering as new as tomorrow.

Those crackling flames can lift your spirits, but your open fireplace actually *wastes* more heat than it delivers. Perhaps you've discovered that tubular grates, glass doors and ordinary fireplace inserts offer only a partial solution at best. Yet a black metal woodstove on your hearth would be an affront to your room decor.

Efficiency on wheels

The Shelburne can transform your fireplace into a super-efficient heat producer without compromising the visual and soul-warming pleasures it provides. You enjoy a visible fire behind safe Corning Pyroceram glass. Downdraft combustion, 2000°F space-capsule insulation and a 40" baffle system help account for its amazing performance. And the Shelburne *rolls out* on your hearth for easy chimney cleaning.



(Black arrows include smoke path through baffling system to flue)

(A) Doors may be opened to view the fire (B) Air is preheated as it enters downdraft and secondary air tubes (C) Firebrick-lined ¼" steel firebox (D) Automatic thermostat (E) Pull-out ash pan (F) Fan with speed control (G) 40" baffling system (H) Flanges in choice of 3 widths permit installation in over 80% of all fireplaces.

© 1981 Vermont Stove Co., Inc.

☐ Rush me your Information Portfolio including complete details on the new Shelburne Fireplace-Stove, insulation sample swatch, and direct-from-manufacturer prices. Enclosed is $1 to help cover mailing costs.

Name _____

Address _____

_____ Zip _____

The Vermont Stove Company

Dept. 2415, Route 7, Shelburne, Vt. 05482

802-985-2593

THE MARKET

Art

AMERICAN INDIAN CRAFTS. Pueblo pottery; Hopi 2nd and 3rd Mesa plaques; Kachinas; old and new rugs No catalogue One-of-a-kind pieces; individually photographed Most priced $100/up: Write for photos and data, specifying interests Box 5896, Sherman Oaks, CA 91413 (213) 789-2559

BIRDS handpainted on assorted items. Brochure 50¢ LSASE, Stray Goose Studio, P.O Box 173N, Marlborough, MA 01752

COLORFUL RASSAYA MASK, Sri Lanka, $28 00, request photo, other masks available, McCoy Imports, Liberty, NY 12754

OLD NATURAL HISTORY PRINTS—Catesby, Edwards, Audubon, Gould's Hummingbirds; shells, botanicals, animals, insects, etc. Free illustrated catalogue Portobello Prints, 1649 Hopkins, Berkeley, CA 94707 (415) 549-1676

WILDFLOWER GIFT CARDS. Full color custom photo prints suitable for framing Sample Calif Poppy card $2.25 Six different cards $10 00 Time Exposure, Box 767, Merced, CA 95341

WHALES—hand-carved pine; blue, humpback, sperm, narwhal Illustrated brochure $1 00. Doug Lind, P.O. Box 74, Burlington, WI 53105



Pre-Columbian Rubbings of Ancient Temple Ruins

DIVING GOD (Mayan 564 A.D.) at Tulum, the walled-city of the Yucatan overlooking the Caribbean—only one of many splendid rubbings! Complete catalog $3 (deductible with order)

BERNARDO
2400 Westheimer 108W (NH5)
Houston, TX 77098

Back Numbers

NATIONAL GEOGRAPHICS, 1888 - 1980, Issues, Book Publications, Collectors Items. Send Wants. Buxbaum Geographics, Box 465-NH, Wilmington, DE 19899

Book Publishers

PUBLISH YOUR BOOK! Join our successful authors Publicity, advertising, beautiful books. All subjects invited Send for fact-filled booklet and free manuscript report. Carlton Press, Dept. NHE, 84 Fifth Avenue, New York 10011

Books

BOOKFINDING. Librarians search worldwide titles or subjects plus 150,000 indexed stock PAB, 2918 Atlantic, Atlantic City, NJ 08401 (609) 344-1943

MAN, RELIGION, AND SCIENCE—A Functional View. $9.95 to Wm. Bailey, P.O Box 985, Santa Barbara, CA 93102

OUT-OF-PRINT, SCARCE, Zoology, Botany, Ornithology, Colorplate, etc. Catalogue $1.00. Book Chest, 19 Oxford Place, Rockville Centre, NY 11570

PUBLISHERS' OVERSTOCKS, BARGAIN BOOKS 2,000 titles, all subjects! Free catalogue: Hamilton, 98-55 Clapboard, Danbury, CT 06810

SOUTH AMERICA BOUND? We've got detailed guidebooks, maps for travellers. Europe, Asia too. Send for free catalogue Bradt Enterprises, 54-N Dudley, Cambridge, MA 02140

"TROPICA"—Cyclopedia of Exotic Plants, 7,000 color photos, 1,136 pages, $115. Request circular Roehrs, Box 125, E. Rutherford, NJ 07073

Camps

Farragut Naval Camps — Boys 9-16

Give your son a summer to remember! Boating & fishing trips. 50-boat fleet with 25 sailboats. All sports. 2 gyms, 3 athletic fields. Outdoor pool. Approved summer school. Opens July 5. Catalog. Also winter school at Farragut Academies in NJ and Florida. Grades 5-12. Farragut Naval Camps. Box ZC, Toms River, NJ 08753 • (201) 349-1121.

Collector's Items

RECEIVE VALUABLE MINERALS MONTHLY! Write today! Free Details! Mineral of the Month Club, 13057-H23 California, Yucaipa, CA 92399

70-110 YEAR OLD MAPS. All States Stamp for Catalogue. Northern Map, Dept HN, Dunnellon, FL 32630

Correspondence

"EARTH FRIENDS" directory interconnects nature-lovers USA-worldwide for friendship, joint-ventures. Free details Box 331499, Miami, FL 33133

MAKE FRIENDS WORLDWIDE through international correspondence Illustrated brochure free! Hermes-Verlag, Box 110660/NH, D-1000 Berlin 11, West Germany

ORIENTAL WOMEN SEEK CORRESPONDENCE for cultural exchange, language practice, friendship Asian Exchange, Honokaa, Hawaii 96727

PENFRIENDS-ENGLAND-USA. Make lasting friendships through correspondence Send age, interests Free reply Harmony, Box 89NH, Brooklyn, NY 11235

Education

EXPLORE MICROSCOPIC WORLD—algae, protozoans, blood cells, etc New Science Course for all ages How to purchase and use a microscope with free brochure. Life Sciences, Box 591R, Woodbury, NY 08096

FIELD COURSES IN NATURAL HISTORY. College Credit Write Aspen Center for Environmental Studies, Box 8777A, Aspen, CO 81612

MAINE ISLAND ECOLOGY Marine biology, botany and ornithology on 200 acre island. Exciting opportunity for high school students interested in environmental studies Faculty-student ratio 1:5. Over 10 years of operation. From June 26 to July 14 or July 18 to August 5 Contact Maine Island Ecology, Academy of Natural Sciences, Nineteenth and the Parkway, Philadelphia, PA 19103

Employment Opportunities

AUSTRALIA NEEDS YOU! Jobs! Paid Transportation! Newest handbook, $2 00 (guaranteed). Australian International Services, Box 19107-RS, Washington, DC 20036

AUSTRALIA—NEW ZEALAND NEED YOU! Big Pay! 50,000 jobs Free transportation Latest listings $2.00. Austco, Box 772, Cypress, CA 90630

AUSTRALIA . . NEW ZEALAND WANT YOU! 17,500 Jobs! Paid Transportation! New Report! $2—Moneyback Guarantee! "Australia Commission," Department 894-C5, National Press Building, Washington, DC 20045

FREE DETAILS—OVERSEAS JOBS! All occupations! 68 countries. Paid fare. Computerized reports. Jobworld, Box 681, Cypress, CA 90630

JOBS OVERSEAS . . (Including Alaska Gas Pipeline) Free Details. Global Employment, Box 808-NH, National City, CA 92050

OVERSEAS—ALL OCCUPATIONS! Worldwide Directory and complete information—$3.00. International Opportunities, Box 19107-RR, Washington, DC 20036

ROCKY MOUNTAIN EMPLOYMENT NEWSLETTER! Colorado, Idaho, Montana, Wyoming! Current openings—all occupations! Free details . Intermountain-4Y, 3506 Birch, Cheyenne, WY 82001

TEACHERS - ADMINISTRATORS: School, college job openings USA, $5 95; Abroad, $5 95 Placement, sources USA, $4 95; Abroad, $4 95 EISF, Box 662, Newton, Massachusetts 02162

Foreign Newspapers

WORLDWIDE ENGLISH NEWSPAPERS 65 countries including Iraq! Sampler: 5/$2 98 Free Brochure. Multinewspapers, Box DE-205, Dana Point, CA 92629

Gourmet Interests

COMMERCIAL COOKWARE BY MAIL! Famous name professional equipment at bargain prices. Calphalon®, Toroware, Henkel, more. Brochure, 25¢. Cook's Warehouse, Box M-1, Montpelier, VT 05602

CORNDISH: A meaty, meal in one casserole—sure to be a family favorite. $1 00 & SASE to A n Z, 417A Nicks Drive, Brooksville, FL 33512

OLD FASHIONED NEW ENGLAND DESSERTS. Easy and delicious $2 P.O Box 4355, Hayward, CA 94540

VEAL: Fancy prime milkfed calves Custom butchered, packaged, frozen. Buy from reputable grower and save Kuehnel Family Farms, Rt. 1, Newton, WI 53063

Government Surplus

JEEPS—$19 30!—CARS—$13 50!—650,000 Items! —Government Surplus—Most Comprehensive Directory Available Tells How, Where To Buy—Your Area—$2—Moneyback Guarantee—"Government Information Services," Dept. DC-5, Box 99249, San Francisco, CA 94109

"GOVERNMENT SURPLUS DIRECTORY." Buy 500,000 items (including Jeeps) . low as 2¢ on dollar! Most complete information available-$2.00. Surplus Disposal, Box 19107-RR, Washington, DC 20036



Hong Kong Market — Virginia Ferrero

Merchandise

ANIMALS, VEGETABLES, MINERALS We have them all! Our 19 page Rubber Stamp Catalogue features over 325 different designs. Send $1.50, Bizzaro Inc., Box 126-NH, Providence, RI 02901

FREE CATALOGUE. Distinctive merchandise for discriminating people. We have Wildlife Prints by the renowned James Lockhart, Austrian backscrubbers, Peoplefeeders, Norwegian Footwear Dryers, Admirals Lamps, things for the den, more. The Armchair Emporium Ltd., 825 Surrey Lane, Dept. NH4, Algonquin, IL 60102

"I LIKE IT WILD® " Wilderness/wildlife posters, T-shirts, notecards. Send stamped envelope: Wilderness Dreams®, Box 4455-N, Shawnee Mission, KS 66204

NAME TAPES—protect clothing from loss at camp, school or anywhere. $4.00 per 100. Send names to Sterling, P.O. Box 110, Winsted, CT 06098

NEW—200 Page 1981-82 catalogue, listing thousands of chemicals, science equipment and labware. Send $2.00 to Merrell Scientific, Dept. N-H, 1665 Buffalo Road, Rochester, NY 14624

PURCHASE BOWIE, Civil War knives, Indian tomahawks. Robert Abels, 2881 N.E. 33 Court, Fort Lauderdale, FL 33306

Miscellaneous

"ALASKA GOLD—Prospecting, Mining, and Investing—An Overview." Based on 40 years experience. Send stamped envelope for Abstract. Yukon Exploration, 507 Third Avenue - Unit 468, Seattle 98104

TREASURE SEARCH. Not gold or silver however, but genuine knowledge of the explorers of old. Oster Expeditions, Inc., a philanthropic organization with a quest for historical information, is seeking contributions to carry out much needed research which will add to historical knowledge as never before. Through these efforts we can better understand previous societies and the early expeditions that discovered the New World. By exploring the past we, as free Americans, can better appreciate the environment in which we live. No one can estimate the extent of scientific knowledge that will be derived from these expeditions, but the opportunity is great. To support the understanding of history through advancements in the field of underwater Archeology and to enhance the history your children will learn, send $20.00 (or what you can afford) to: Oster Expeditions, Inc., 2733 Shelter Island Dr., Suite 293, San Diego, California 92106

Photography

DISCOVER Colorado. Quality color slides. Free brochure: Greg Photos, Rm. 2, Box 342, Arvada, CO 80001

PHOTOGRAPHER NEEDS INFO on buildings, houses, restaurants, etc. shaped like animals, vegetables, objects for photo essay. James Andrews, 243 Westend Avenue, New York City 10023

"PHOTOGRAPHY IS A VISUAL FEAST." An extremely clear book on taking and developing your own pictures. Send $6.95 to Box 875, Mendocino, CA 95460

Optics

BINOCULAR SALES AND SERVICE. Repairing binoculars since 1923. Alignment performed on our U.S. Navy collimator. Free catalogue and our article "Know Your binoculars," published in Audubon Magazine. Mirakel Optical Co., Inc., 331 Mansion St., West Coxsackie, NY 12192 (518) 731-2610

HUGE DISCOUNTS. Nationally Advertised Brands. Binoculars, Spotting Scopes. Orders shipped prepaid. Free price list. Sandan Associates, Box 986, Delray Beach, FL 33444

LEITZ, ZEISS, B&L, SWIFT, BUSHNELL, NIKON, Optolyth binoculars, telescopes and accessories. Send stamp for discount list. Specify literature desired. Large stock. Orders filled postpaid day received. Birding, Box 5N, Amsterdam, NY 12010

OPTIC DISCOUNTS. Binoculars—Telescopes—Brand Names—Free Catalogue. Thos. Manetta, 61 Hoffman Avenue, Elmont, NY 11003

Real Estate

FREE 296-PAGE CATALOGUE. Describes and pictures over 2,800 farms, ranches, acreages, businesses and town and country homes from coast to coast. United Farm Agency, Inc., 612-V W. 47th St., Kansas City, MO 64112. Ph. Toll-Free: 1-800-821-2599, MO. Res. Ph. Toll-Free: 1-800-892-5785

GOVERNMENT LANDS FROM $7.50/ACRE! Homesites, farming, vacationing, investment! "Land Buyer's Guide" plus nationwide listings—$2.00. Surplus Lands, Box 19107-RR, Washington, DC 20036

NEW! FREE! Big Summer Catalogue! Over 5,400 country properties described, pictured! Land, Farms, Homes, Businesses, Recreation, Retirement buys! Selected best thruout the U.S. Over 700 offices, 43 states. All Across America! Yours Free from the World's Largest! Strout Realty, Inc., 60 E. 42nd Street, Dept. 5390, New York, NY 10017

SMALL, INNOVATIVE, ENERGY-EFFICIENT Town under design in north Florida on the water amid giant live oaks. Peaceful, healthy setting to live and work. To receive quarterly newsletter on progress, send $4 to A. Miller, 18600 S.W. 157th Avenue, Miami, FL 33187

Recordings

VOX/TURNABOUT—CANDIDE. Classical. Catalogue including Storyville Jazz-50¢ postage. Sampler recordings: Bravo Beethoven, Magic of Mozart, Baroque Hits of 1710 (including Pachelbel Canon), Best of Bach-only $2.50 each. 75¢ each postage. All four only $10. Postpaid, plus Bonus album "Hits of 1750." Free catalogue included. Specify records or cassettes. Mostlee Music, Div. MMG-NH, 48 W. 38th Street, NY, NY 10018

Rentals

ADIRONDACK LODGES on Upper Saranac Lake. Available for two weeks or a month, July through September. Everything provided for comfortable living in the quiet woods. From $650–$1,700 for two weeks. Please write Bartlett Carry Club, RFD 3, Tupper Lake, NY

ADIRONDACK WILDERNESS HIDEAWAY on private lake Saranac region. Monthly Lodge $1250 July, August, $1,000 June, September. Cabin $650 July, August, $500 June, September. Call (212) 546-9202 weekdays.

OLD FASHIONED, SECLUDED FARM on Cape Breton Island offers log cabins, excellent meals, peace to a few guests. $225/week. Write J. Gardner, Orangedale, Nova Scotia

SALTWATER FARM COTTAGES. Fully equipped. Pastures, Woods, Rocky Shore, Animals. $175 weekly. Jonesboro, ME (207) 434-2701

Resorts

ADIRONDACK WILDERNESS, sparkling mountain lake, informal, great tennis, food, hiking, horses, family rates. American Plan. Timberlock, Box NH, Indian Lake, NY 12864

MAINE: remote lodge, superb fly-fishing, hiking-Gulf Hagas, moose watching, berrying. Excellent food, maximum 10 guests. Little Lyford, Brownville, ME 04414

VACATION/RELAXATION—Birdwatcher's delight—Peaceful, secluded nature lover's mountain retreat. Cave Creek Ranch, Portal, Arizona 85632

Tours/Trips

A TRIP OF A LIFETIME. Galapagos and Inca Peru. A small group tour offering individual attention. Two departures for two weeks each. August 12, 1981 and February 1982. Cost $2,698 U.S. per person. Limited space available. For further information contact Wings of the World, Inc. Travel, 653 Mt. Pleasant Road, Toronto, Canada (416) 482-1223

ADVENTURES IN AFRICA and everywhere. Gorilla photo-safari through Rwanda and Zaire. Camping in Tanzania's Serengeti Ecology safari in Parks and remote areas of Kenya. Over 25 wildlife trips including India, Nepal, Galapagos, Mexico, Hawaii & Alaska. Birding trips in Arizona, Ecuador, Africa. Photograph mountain gorillas, polar bears, asian rhinos, rare birds. Small groups with expert leaders. Adventures International, 4421-N Albert St., Oakland, CA 94619

ALASKA DISCOVERY—"Dedicated to the Enjoyment and Conservation of the Great Alaskan Wilderness." Wilderness adventure trips by kayak, canoe, backpack or skis. One to ten-day completely outfitted expeditions throughout Southeast Alaska. Admiralty Island, Juneau Icefield, Glacier Bay, Chichagof Island, Hubbard Glacier. Alaska's outside coast. University accredited natural history courses. Experienced, certified Alaskan wilderness guides. Award winning program of minimum impact camping, natural history emphasized. For brochure: Alaska Discovery, P.O. Box 26NH, Gustavus, Alaska 99826. Ph: (907) 697-3431

ALASKA TRAVEL ADVENTURES—Experience Alaska in guided intimate group trips. Backpacking, canoeing, kayaking, whitewater, wildlife photography, fishing, custom trips. Alaska-Hawaii Combinations. Free catalogue describes 50 different trips throughout Alaska for all ages and abilities. Contact Alaska Travel Adventures, 499 Hamilton Ave., Suite 212-AAA, Palo Alto, CA 94301. In California call collect (415) 329-9013, elsewhere toll free (800) 227-8480

ALASKAN WATER ADVENTURES. Kayaking, Rafting, Birding in Prince William Sound and Copper River Basin. Open Door, Box 1185N, Cordova, Alaska 99574 (907) 424-7466

ARCHEOLOGICAL FIELD SCHOOL—8 week field school in archeological excavation on Wester Anasazi site in southwest Utah. June 15 to August 8. No previous experience required. 15 quarter credits. Non-credit participation by adult avocational archeologists open for 2 to 8 week periods. Total enrollment limited to 20. For cost information write to Dr. Richard A. Thompson, Southern Utah State College, Cedar City, Utah 84720

BE A SPARETIME TRAVEL AGENT. detailed guidebook explains how, profits, travel benefits. $3.95. SAV Travel Box 571-NH, Hicksville, NY 11802

BICYCLE TOURS OF CHINA—exclusive with China Passage. Tours leaving approximately every two weeks for PRC. Send for brochure. China Passage, 302 Fifth Avenue, 10th Fl., NYC 10001 or call (212) 564-4099

BIRDS WORLD RECORD: "Explorer's Inn," Amazonas, Peru. Abundant other Fauna, Flora. Forum Travel, 2437 Durant, Berkeley, California 94704 (415) 843-8294

CANOE WILD MAINE—Learn woods skills and natural history while canoeing northern Maine. Individuals, families, and conservation organizations welcome. Special courses with colleges. North Woods Ways, Box 34, Salisbury Cove, ME 04642

GALAPAGOS ECUADOR/PERU. Economic guided tours from $1532. 8 to 15 days. Galapagos, all meals. Weekly departures. Options: Quito, Amazon, Cuzco/Machu Picchu. University credit available. Details: J.A. Colley, LAST Inc. 43 Millstone Road, Randallstown, MD 21133 (301) 922-3116

GALAPAGOS HIKING AND SAILING EXPEDITIONS. Machu Picchu option. Also exhilarating horseback expedition to Peru and Machu Picchu. Inca Floats, 5982N Balboa, Oakland, CA 94611 (415) 339-9095

HIMALAYAN TRAVEL, INC. Trekking expeditions in the Everest and Annapurna areas of Nepal. Exotic cultures, spectacular mountain scenery. Box 481-NH, Greenwich, CT 06830. Toll Free (800) 243-5330

HUMPBACK WHALES OFF SOCORRO. Field study January 3-10, 1982 to rarely visited Socorro, one of the Revillagigedo Islands off Baja California, which are comparable to the Galapagos as a demonstration of evolution and speciation. Island biology, hydrophone recording of whale songs, study of an outstanding population of marine birds. Write: University of California Extension, Natural Environment Desk H, 2223 Fulton St., Berkeley, CA 94720 (415) 642-1061

INTERNATIONAL NATURE & TREKKING TOURS. Galapagos, Peru, Nepal, Ecuador, Alaska, Tanzania, Kenya, Patagonia, Falkland Islands, Costa Rica, Guatemala and more. Expert leaders. Very small groups. Write: Wilderness Travel (formerly South American Wilderness Adventures), 1760-NH Solano Avenue, Berkeley, CA 94707

LEGENDARY CULTURES, FASCINATING NATURE: Special Programs to Latin America and Africa Groups/Individuals. Also: Europe and China. Forum Travel, 2437 Durant, Berkeley, California 94704 (415) 843-8294

NATURALIST GUIDED FIELD SEMINARS and tours, West Texas and Mexico. Rafting, hiking, backpacking, bus. University or Continuing Education credit as appropriate. Write Education Department, Chihuahuan Desert Research Institute, Box 1334, Alpine, TX 79830

NATURE PHOTOGRAPHY field work and instruction in remote, mountain locations throughout the West. Brochure. The Natural Image, P.O. Box 45, Winthrop, WA 98862

OCEAN SEARCH—nature expeditions in search of whales and pelagic birds in the Bay of Fundy. For more information, see ad on page 22

ORIENTAL ECLIPSE EXPRESS. China—Mongolia—Siberia. Hong Kong, Nanking, Sian, Peking, Ulan Bator, Lake Baikal, Irkutsk, and Bratsk. View 31 July 1981 Solar Eclipse. 21 days-$3595. Baylis-Todd Eclipse Tour, Claremont Hotel, Berkeley, CA 94705 (415) 849-4333

SAVE ON LUXURY CRUISES! (Passenger ship or Freighter) How? Ask TravLtips, 163-09 Depot Road, B515, Flushing, NY 11358

TRAVEL PHOTOGRAPHY WORKSHOP IN SANTA FE with Lisl Dennis, author of "How to Take Better Travel Photos," HP Books. Aug 29-Sept 5 and Sept 5-12. P.O. Box 2847, Dept X, Santa Fe, NM 87501

WILDERNESS TRAILS IDAHO. Backpacking, Ski-touring, and Bicycle-touring. Come adventure and learn with us. Trips for all abilities, everything provided. We have thirteen years experience and guide only in Idaho. Write: P.O. 9252 M, Moscow, Idaho 83843 (208) 882-1955

RATES AND STYLE INFORMATION

$1.75 per word; 16 word ($28) minimum. *Display classified* is $150 per inch. All advertisements must be prepaid. Rates are not structured for agency or frequency discounts. All advertisements are accepted at NATURAL HISTORY's discretion. Send check/money order payable to NATURAL HISTORY to: The Market, NATURAL HISTORY Magazine, Central Park West at 79th St., New York, NY 10024. Please include your personal address and telephone number, issue preferred, and suggested heading. Deadline—8th of month, two months prior to cover date (the January issue closes Nov. 8). Camera-ready art is required for display ads. A tearsheet or copy of the page with your ad will be sent upon publication.

Box numbers, telephone numbers, and hyphenated words count as two words; abbreviations and zip codes as one word each. All states are shown in two-letter code followed by zip, then telephone (with area code), if desired. Occasionally, slight editing is required for clarity. Thank you!

Frozen Fish

Frozen fish is definitely déclassé in the world of *haute cuisine*. But to the American Museum of Natural History, one frozen fish is so desirable that the Museum has been going to great lengths to obtain it.

For six months, Guido Dingerkus of the Ichthyology Department has been trying to arrange the delivery of a frozen coelacanth from Zimbabwe to New York. Unfortunately, shipping a 120-pound frozen fish halfway around the world is not like shipping fish sticks from Cape Cod to Des Moines. Dingerkus has run into a long series of problems and delays that threaten to prevent the fish from ever reaching the Museum.

The coelacanth is often called a living fossil because until recently it was believed to have been extinct for 30 million years. It is a fascinating animal for several reasons. Some zoologists think it is closely related to the primitive, lobe-finned group of fishes that gave rise to the first land vertebrates, the amphibians, which eventually led to *Homo sapiens*. By studying the frozen fish, it may be possible to learn more about the transition of vertebrate life from water to land.

The coelacanth in question was caught in June of 1980 off the Comoros Islands (near Madagascar), the only area where coelacanths are found. The local Comoros fishermen know that these strange, lobe-finned fish will sometimes fetch high rewards if preserved. (Before the living coelacanth was discovered by scientists, the islanders had been catching and eating them, as well as using their skin for patching bicycle tires.) Someone apparently thought that a frozen coelacanth would fetch more money than a preserved one and stored it in a meat locker. It was put up for sale at $2,000 (or $17 per pound — not bad when you consider the price of lobster tails), but after several months with no buyers, the discouraged entrepreneur donated the fish to the National Museum of Zimbabwe.

Only two frozen coelacanths have entered the United States. Both were caught by an expedition of the California Academy of Sciences led by John McCosker, who tried unsuccessfully to capture a live coelacanth to exhibit at Steinhart Aquarium in San Francisco. Frozen coelacanths are superior to preserved ones because their biochemicals, chromosomes, and cell structures remain intact.

When Dingerkus learned of the frozen coelacanth in Zimbabwe, he contacted the director of the national museum there. The director told him that his museum only wanted a cast of the fish; the American Museum could have the original. Dingerkus was delighted and promised to send him a first-rate cast when the fish came in.

Gary Littman of Sloan-Kettering Institute, who had long wanted to study the blood and muscle proteins of the coelacanth, volunteered to pay all shipping expenses. Furthermore, an airline, hoping for some publicity, agreed to ship the fish free of charge. Everything seemed settled.

But months passed and the fish never arrived. After numerous telephone calls, Littman and Dingerkus found out that the airline people had changed their mind: not only did they refuse to deliver the fish for free, they were not going to deliver it at any price. No other airline, it turned out,

Illicit Antiquities

Visions of Antiquity: Licit and Illicit, a series of films followed by discussions, will be presented in the Auditorium on three Mondays—May 4, 11, and 18—at 7:00 P.M. *The Plunderers: Treasure Trail* examines the illegal digging and plundering of ancient tombs by poor Turkish farmers. *The Plunderers: The Hot Pot* investigates the Metropolitan Museum of Art's controversial, million-dollar purchase of the Euphronios vase, which was probably stolen from a tomb, and documents the destruction of Etruscan and Egyptian antiquities by tomb robbers. *The Royal Archives of Ebla* shows the recent excavations in Syria that have unearthed 17,000 clay tablets. The tablets, which are still in the early stages of translation, seem to be related to biblical texts. Tickets for the series are $18 ($12 for members); call the Education Department for more information.

Forever Young

In his new documentary, *Forever Young*, Academy Award-winning director Robin Lehman talks to elderly people

would guarantee delivery of a fully frozen fish, and a rotten coelacanth is far worse than no coelacanth at all.

"It was back to square one," says Dingerkus. "Here we had this frozen fish of great scientific value, and no way to get it." After several more weeks of haggling, he finally convinced the airline to transport the fish for its usual shipping costs—about $5,000. The fish will be packed in 120 pounds of dry ice and crated. If all goes well, it might be in the Museum's freezer next month, sharing quarters with a frozen rhinoceros, a pile of frozen sharks, and other frozen animals.

The thawing of the coelacanth, Dingerkus explained, will be a major scientific event. "A fair number of scientists will be flying in from different parts of the country to work on the fish. As it thaws from the outside, we will begin dissecting when it is semifrozen, semisquishy. It is more critical to get certain things out fast. Everyone will get a piece."

But with shipping difficulties continuing, Dingerkus thinks this may all be wishful thinking. "I'll only believe we've got it when I see it sitting in our freezer."

If the fish ever arrives, it will be the Museum's third coelacanth. In 1961, the first coelacanth sent to North America arrived at the Museum in a large coffin. The local Comoros fishermen had carried it to a hospital, where one of the surgeons recognized it and emptied his hospital of Formalin (a solution similar to embalming fluid) to preserve it.

The fish was finally dissected by a team of Museum scientists in 1972. To everyone's astonishment, out popped five fully-formed young, immediately settling the question of whether the coelacanth lays eggs or bears live offspring. The American Museum sent one of the young to the Paris Museum of Natural History and received an adult male in return, thus rounding out the collection.

This pregnant female was, not surprisingly, the heaviest coelacanth ever caught. The frozen fish that the Museum is trying to acquire is almost as heavy and thus may also be pregnant. Says Dingerkus, "We're secretly keeping our fingers crossed."

Douglas J. Preston

and dispels many of the fears and prejudices associated with growing old. Sponsored by the Education Department, the free film will be shown on Sunday, May 3, at 2:00 P.M. in the Auditorium.

African Diaspora

African Diaspora: Caribbean Expression, a series of films on African traditions that were brought to the New World, will be shown on two Wednesday evenings, May 20 and 27, at 7:00 P.M. in the Auditorium. The series, presented by the Education Department, will explore, in particular, African religious systems found in the New World, such as the condomble of Brazil and the voodoo of Haiti.

Traditional Voices

Versions of the Traditional, a series of poetry readings and songs sponsored by the Education Department and the Touchstone Center, includes two free programs in May. The first, on May 6, will present readings of the Nuer of Ethiopia; the second, on May 20, will be on Eskimo poetry.

From Russia with Love

On Sunday, May 10, the graduating class of the High School of the Performing Arts will present *Panorama of Dance,* featuring a variety of dance forms from Russian classics to contemporary American. The free dance concert, presented by the Education Department, will be given in the Auditorium at 2:00 P.M.

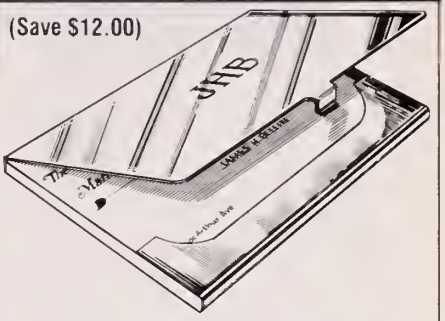
Museum Highlights

Every day in the Museum, free tours of selected exhibition halls are available for individuals, families, and groups of up to twenty people (although not for school or day-care groups). Check in at any Information Desk when you visit to find out about tours available on that day. For more information on personalized group tours, including some for non-English-speaking visitors, contact the Volunteer Office at (212) 873-1300, ext. 538.

For more information about programs, call the appropriate department: Membership Office (212) 873-1327; Education Department (212) 873-7507; Planetarium (212) 873-1300, ext. 389.

Look-alikes Sell For ~~$28~~ Now! SALE PRICED at $7.98

(Save $12.00)



The Top-Brass CARD HOLDER

What a *classy* impression you'll make — drawing your business cards, credit cards, or ID's from this elegant, efficient case! Keeps cards clean . . . neat . . . together. Handsomely covered in status satin brass, with the option of your initials engraved for the final prestige touch. Slim 2¼" x 3⅝" to fit in pocket or purse. Sensational gift, too! Order today! **Engraved cases** (#422): State your 3 initials and add $2.00 to below prices for each holder engraved. **Plain cases** (#430): 1/$7.98 + $1.25 postage and handling; 2/$14.88 + $1.75 p/h, 3/$21.97 + $2.25 p/h; 4/$28.97 + $2.75 p/h, 5/$35.95 + $3.25 p/h; 6/$41.97 + $3.75 p/h. NJ residents add 5% sales tax. MC/Visa welcome (Card #, exp date), 201 - 546-5507. **SATISFACTION GUARANTEED**

DORSAY MARKETING, Dept. CH1026
142 MacArthur Ave. • Box A • Garfield, NJ 07026

© 1980 Dorsay

WHEN YOU WRITE TO NATURAL HISTORY

about a change of address, renewal of subscription, billing, or any kind of adjustment, send the present address label from the magazine wrapper.

Moving? Please notify 6 weeks in advance. You can use this form to tell us about a move or order a subscription.

Change of address—Attach your address label in the dotted area and fill in your new address below, clip and mail to Natural History Membership Services, P.O. Box 4300, Bergenfield, N.J. 07621.

Cut your old address label from magazine wrapper and attach over this area.
Fill in your NEW address and mail to:
Natural History Magazine
Membership Services P.O. Box 4300
Bergenfield, N.J. 07621

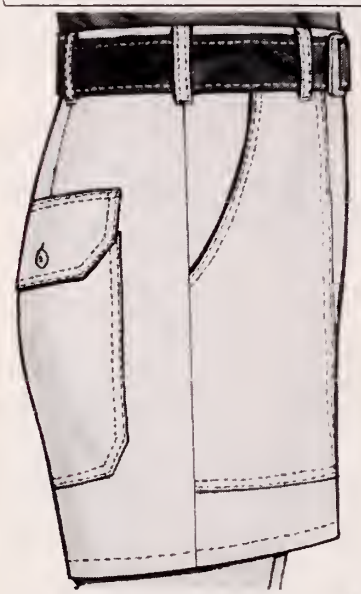
PLEASE PRINT

Name _____

New Address _____

City _____ State _____ Zip _____

Mountain Shorts



You don't climb mountains?

Most of us don't! But we do spend a lot of time at the beach, boating, hiking, touring or just plain hammocking. Here's the most comfortable, most practical pair of shorts to come along in years, from Haband – the Surprising Savings Company in Paterson, N.J.

HUGE POCKETS! HUGE SAVINGS!



These are the real thing, with the full 12" deep front pockets, tough reinforced double track stitching, big 8 x 7 inch cargo type buttoned flap back pockets, the works – Even the heavy, deluxe "Kilimanjaro Cloth" No-Iron polyester and cotton.

Great fitting, great feeling masculine shorts, in colors Desert Tan, Slate Blue, and Loden Green, or Country Club Burgundy. Even waist sizes 30 thru 54 IN STOCK!

HABAND 265 N. 9th St., Paterson, N.J. 07530

Mountain Shorts **2** pairs for **19.95**

3 pairs 29.75

HABAND – Executive Division
265 N 9 St., Paterson, NJ 07530
Please send me the shorts specified for which I enclose $.....
+ $1 25 toward shipping.

Available in Sizes 30 thru 54 (Sizes 46 thru 54, add $1 25 ea pair)

Or Charge To: ☐ VISA ☐ MasterCHARGE

Acct #_____
Exp__/__/__

If on receipt I do not choose to wear them, I may return the shorts within 30 days for full refund of my remittance.

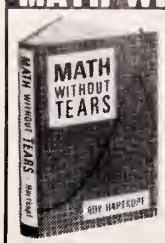
750-056

Colors		Qty.	Size
TAN	A		
BLUE	B		
GREEN	D		
Burgundy	E		

Name_____
Street_____ Apt. #_____
City_____
State_____ Zip

HABAND for MEN

MATH WITHOUT TEARS



Using non-technical language and a light touch Roy Hartkopf gives you a basic understanding of many everyday applications of mathematics. He takes the reader from simple counting to trigonometry and calculus, emphasizing the practical aspects of math. Humorously written.

Learn math in the comfort of your own home at minimum cost.

Order Now: $9.95 plus $1.10 hdlg.

EMERSON BOOKS, INC.
Dept 705 F Buchanan, N Y 10511
10 Day Money Back Guarantee

Mount St. Helens (p. 36)

Recently revised to include a description of the Mount St. Helens eruption, S.L. Harris's *Fire and Ice* (Seattle: Pacific Search Press, 1980) is a classic, semipopular account of the geology of the seventeen major Cascades volcanoes. Meant for the general scientific audience, C.L. Rosenfeld's "Observations on the Mount St. Helens Eruption" (*American Scientist,* vol. 68, no. 5, pp. 494–509) is a clear description of the recent eruptions of Mount St. Helens. "The Eruptions of Mount St. Helens," by R. Decker and B. Decker (*Scientific American,* March 1981, pp. 68–80) covers the mountain's history, the effects of the recent eruptions, and the prospects for future volcanic activity. Less technical are R. Findley's "Mountain with a Death Wish," "In the Path of Destruction," and "The Day the Sky Fell" (*National Geographic,* January 1981, pp. 3–65), which cover the eruption and its consequences for the environment, the economy, and the geology of the area. Among the many picture books that have appeared on the eruption are *Volcano: The Eruption of Mount St. Helens* (Longview: Longview and Madrona Publishers, 1980); *Mt. St. Helens: Holocaust* (Lubbock: C.F. Boone Publishers, 1980); and *Mt. St. Helens—The Volcano Explodes!* (New York: SINO Publishing Co., 1980). For background reading, P. Francis's *Volcanoes* (New York: Penguin Books, 1976) is a lucid introduction to the history, structure, and formation of volcanoes.

Anglerfish (p. 50)

Using high-speed, light cinematography, D.B. Grobecker and T.W. Pietsch show that shallow-water anglerfish have one of the fastest vertebrate feeding mechanisms known. They describe the fish's rapid prey capture in "High-Speed Cinematographic Evidence for Ultrafast Feeding in Antennariid Anglerfishes" (*Science,* September 14, 1979, pp. 1161–62). In "The Compleat Angler: Aggressive Mimicry in an Antennariid Anglerfish" (*Science,* July 28, 1978, pp. 369–70), T.W. Pietsch and D.B. Grobecker describe how an anglerfish of the genus *Antennarius* conserves energy by using a bait that mimics a small fish to attract prey. A short article describing the anglerfish and its behavior, "Strange Animal Lures," by J.W. Atz (*Animal Kingdom,* July–August 1950, pp. 110–13) also discusses similar phenomena of mimicry in the alligator snapping turtle and the copperhead snake. W.G. Eberhard explains how a mature female bolas spider attracts prey with a volatile substance that mimics the female sex-attractant pheromone of a fall armyworm in "Aggressive Chemical Mimicry by a Bolas Spider" (*Science,* December 16, 1977, pp. 1173–75).

Dugongs (p. 54)

In 1888, tired of lecturing about things he had never seen, zoology professor A.C. Haddon left Dublin to research coral reefs and marine fauna in the Torres Strait, but soon became more interested in the people. Ten years later, Haddon returned to the Torres Strait as head of a Cambridge University expedition that conducted the first scientific interdisciplinary study of a primitive people. The results of this classic study, edited by Haddon, were published in six volumes, *Reports of the Cambridge Anthropological Expedition to the Torres Strait* (Cambridge: Cambridge University Press, 1901–35). Haddon also wrote a popular account of his research, *Headhunters: Black, White and Brown* (London: Methuen and Co., 1901). More recent material on Torres Strait Islanders can be found in *Sunda and Sahul,* a work on prehistoric societies in Southeast Asia, Melanesia, and Australia, edited by J. Allen, J. Golson, and R. Jones (London: Academic Press, 1977), that includes D.R. Harris's "Subsistence Strategies Across Torres Strait." Harris also looks at the relationships be-

tween island size and resource base, trade, and the development of socio-economic systems in "Foragers and Farmers in the Western Torres Strait Islands: An Historical Analysis of Economic, Demographic, and Spatial Differentiation" (*Social and Ecological Systems,* edited by P. Burnham and R.F. Ellen. London: Academic Press, 1979). The first European contacts with Torres Strait Islanders are the focus of D.R. Moore's *Islanders and Aborigines at Cape York* (Canberra: Australian Institute of Aboriginal Studies, 1979) and *The Journal of John Sweatman,* edited by J. Allen and P. Corris (Brisbane: University of Queensland Press, 1977). In "The Wind Caller" (*Natural History,* March 1977, pp. 10–16), B. Nietschmann recalls some of the experiences he and his family had while learning about the Islanders' knowledge of the environment. M. Lawrie's *Myths and Legends of Torres Strait* (Brisbane: University of Queensland Press, 1970) is a nicely illustrated collection of many old tales. Australian novelist I.L. Idriess wrote several books based on a rather loose interpretation of Torres Strait cultural history, such as *The Drums of Mer* (Sydney: Angus and Robertson, 1933) and *Wild White Man of Badu* (Sydney: Angus and Robertson, 1950). Literature on dugongs is slim, but has recently been increasing. A good, although dated, overview of dugong numbers and habitats can be found in G.C.L. Bertram and C.K.R. Bertram's "The Modern Sirenia: Their Distribution and Status" (*Biological Journal of the Linnaean Society,* vol. 5, no. 4, 1973, pp. 297–338), which includes a section on dugongs in the Torres Strait. Zoologist G. Heinsohn has been studying dugongs since 1969; some of the results of his research are summarized in "Sirens of Tropical Australia" (*Australian Natural History,* vol. 19, no. 4, 1978, p. 106–111). Heinsohn collaborated with P. Anderson on "The Status of the Dugong and Dugong Hunting in Australian Waters: A Survey of Local Perceptions" (*Biological Conservation,* vol. 13, 1978, pp. 13–26). Heinsohn, Anderson, and H. Marsh wrote "Australian Dugong," a good, illustrated review of habitats, behavior, and ecology (*Oceans,* May–June 1979, pp. 48–52). P. Anderson presents the results of his research at Shark Bay, Western Australia—one of the few places where dugongs are not hunted—in "Dugong Behavior: On Being a Marine Mammalian Grazer" (*The Biologist,* vol. 61, no. 4, 1980, pp. 113–44). R. Bustard's *Sea Turtles* (New York: Taplinger, 1972) includes some discussion of sea turtles in the Torres Strait.

Purple Martins (p. 64)

A complete guide to the purple martin meant primarily for the layman, R.B. Layton's *The Purple Martin* (Jackson: Nature Books Publishers, 1971) contains information on the martin's migration, what it eats, how it nests, and also gives hints on building a martin house. A classic work on purple martins is R.W. Allen and M.M. Nice's "A Study of the Breeding Biology of the Purple Martin" (*American Midland Naturalist,* vol. 47, no. 3, 1952, pp. 606–65). *The Nature Society News,* formerly the *Purple Martin News,* devotes most of its pages to purple martins. Published by the Nature Society, Purple Martin Junction, Griggsville, Illinois 62340, this newspaper regularly features a guide for new members entitled "How to Become a Purple Martin Landlord." Also published by this society is J.L. Wade's popular paperback, now in its seventh printing, *What You Should Know About the Purple Martin* (Griggsville: The Nature Society, 1979). R.F. Johnston and J.W. Hardy's "Behavior of the Purple Martin" (*Wilson Bulletin,* vol. 74, September 1962, pp. 243–62) is a detailed, descriptive account of reproductive, aggressive, and group behavior of purple martins.

Rita Campon



Enter the world of Questers nature tours.

When you travel with Questers, you have the advantage of our knowledge of the travel world And our experience of the natural world We are travel professionals And our only tour program is Worldwide Nature Tours

Under the leadership of an accompanying naturalist, we search out the plants and animals, birds and flowers rain forests, mountains, and tundra seashores, lakes, and swamps of the regions we explore. At the same time, we include the more usual attractions in touring—the cities, archaeological sites, and people

The current Directory of Worldwide Nature Tours describes 29 tours varying from 9 to 36 days and going to virtually every part of the world Included are The Amazon, Peru, Patagonia, Galapagos, Hawaii, Alaska, Death Valley, Everglades, Ladakh, Sri Lanka, Iceland, Scotland, Greece, Australia, and New Zealand Tour parties are small, the pace leisurely, and itineraries unusual

Call or write Questers or see your Travel Agent today for your free copy of the Directory of Worldwide Nature Tours

QUESTERS

Questers Tours & Travel, Inc.
Dept. NH 581, 257 Park Avenue South
New York, N.Y. 10010 • (212) 673-3120

ARMENIA

CROSSROADS OF CULTURES



A stunning booklet which effectively reviews the course of Armenia s 3000-year history and culture ■ With sections on history, ways of life, language and literature music, architecture, painting, ceramics, rugmaking, costumes, coinage and metalwork ■ An accurate and entertaining account, richly illustrated ■

To order:
Mail $2 50 check payable to
Museum Shop
American Museum of Natural History
Central Park West at 79th St , N Y , N Y 10024
Add sales tax where applicable
Discount for large orders

Name

Address

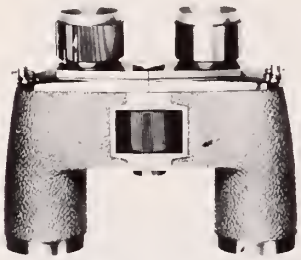
City State Zip

PERU
CUSCO — MACHU PICCHU
THE AMAZON

The largest variety of tour packages including First Class and Delux hotels, at the lowest price ever.

CALL NOW—TOLL FREE 1-800-223-1367
IN N.Y. CALL COLLECT (212) 582-7811
VALISHA TRAVEL
250 W. 57th. St.
N.Y.C. 10019

Treasures From The Earth
Color Portfolio of Natural Specimens and Catalog of Minerals, Display Stands, Books and Natural Jewelry, $3.00
Dover Scientific
Box 6011C Long Island City, NY 11106



BUSHNELL 7x35 CUSTOM
Mfg. List $280.00 Postpaid $164.00
This is an example of the deep discount prices on high quality optics that is found in our FREE catalog. This catalog lists and illustrates an outstanding selection of telescopes, binoculars etc., plus valuable information on how to properly select them. Write for it today.
GIL HEBARD OPTICS
COURTHOUSE SQ., KNOXVILLE, ILL. 61448

WHEN YOU WRITE TO NATURAL HISTORY

about a subscription renewal, billing, or any kind of adjustment, please include your present address label.

Moving? Please notify 6 weeks in advance. Send your present address label along with your new address to Natural History Membership Services, Box 4300, Bergenfield, NJ 07621

Name
New Address
City State ZIP
Please Print Attach Label

Beastly Rights

by Joseph Kastner

RECKONING WITH THE BEAST, by James Turner. *The Johns Hopkins University Press, $14.00; 190 pp., illus.*

A few months ago, a vociferous group of animal welfare organizations cornered a big American corporation and made history for their cause. Revlon Inc., besieged by protests that it was cruel to use laboratory rabbits to find out if its eye makeup might irritate customers' eyes, gave three-quarters of a million dollars to Rockefeller University to develop tests that would not use—or maybe misuse—live animals.

The company's humane action came, not from the heart, but from the bottom line, the threat to its good name and profits. In surrendering, Revlon may have felt that it had been sandbagged by a band of zealots. But, as it could discover by reading *Reckoning with the Beast,* the company was really being pushed by one of the most pervasive forces in our society: the animal protectors, who according to author James Turner represent "a new and distinctly modern sensibility."

Unlike so many recent books on our inhumanity to animals, which veer between emotionalism and pragmatism, *Reckoning with the Beast* is cool-headed history, ironic rather than indignant in tone, wide-angled rather than tunnel in its vision. Awesomely researched but admirably brief, it gives a lucid background for the current arguments over animal rights, a term that has joined civil and women's in the contemporary litany of rights.

The term itself is not new. Jeremy Bentham in 1780 matched the rights of animals to the revolutionary doctrine of the rights of man. For centuries before that, however, the idea that animals had any rights went against the grain of Western thought, which denied them a reasoning soul. Ergo, neither the concept of cruelty nor of pity could be applied to animals. A mischievous thinker like Montaigne might, in the sixteenth century, remark that it was only man's vanity that set him apart from his "fellow members and companions" of the animal kingdom. But not until the eighteenth century was the companionship generally recognized.

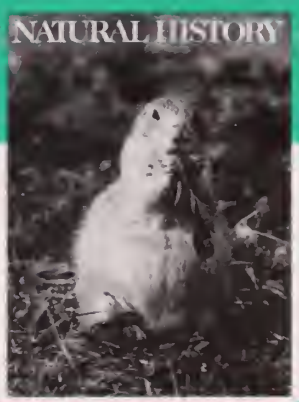
The concept was expressed in two quite different works. In 1776, a British cleric named Humphrey Primatt published *A Dissertation on the Duty of Mercy and Sin of Cruelty to Brute Animals.* He put forward the radical idea that "pain is pain whether it is inflicted on man or beast." Inflicting it on either was equally evil. The same message went out from the first English book of children's fiction, *Goody Two-Shoes,* whose heroine, Marjorie Meanwell, set an example for all children by tirelessly rescuing suffering cows and horses.

The dread of pain, Turner holds, is "uniquely characteristic of the modern era." The concept that animals feel pain as people do was the basis for the animal protection movement that sprang up so rapidly in England and America in the nineteenth century. The first of many cruelty to animals bills was introduced into Parliament in 1809 by a former Lord Chancellor who had, among his many pets, a goose and two leeches. And even earlier, a jury in Boston, which actually had no law to go by, had indicted a man for the "depraved" beating of his horse.

The original Society for the Prevention of Cruelty to Animals was formed in London in 1824. It drifted along until an inventor named Lewis Gompertz took over. Although very effective, Gompertz was somewhat eccentric—he refused to eat meat or milk or ride in a horse-drawn carriage—and he was a Jew. It was only after he was eased out of office that the peerage became the society's governing body and Queen Victoria graciously permitted appending "royal" to the title. The RSPCA thrived.

This was noted by Henry Bergh, a rich young American who, though

This is for me.



◯ I want to join the American Museum of Natural History and get, with my one-year membership, 12 issues of **Natural History** for $15.

◯ I want to give a gift of **Natural History** along with a one-year Associate membership in the Museum. Bill me later @ $15.

◯ I want to splurge and do both. Bill me later @ $15 per subscription.

I understand that each membership-subscription includes: free admission to the Museum *and* discounts at the Museum Gift Shop.

Send bill to:

My Name _____

Address _____

City _____ State _____ Zip _____

Enter my own subscription, too: ◯ New ◯ Renewal

I prefer: ◯ 2 years at $26 ◯ 3 years at $35

Send gift subscription to: J506

Name _____

Address _____

City _____

State _____ Zip _____

I prefer to give: ◯ 2 years at $26 ◯ 3 years at $35

Please allow 7 weeks for shipment of first copy. Outside U.S.A. add $3 per year for postage.

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO. 30 BERGENFIELD, NJ

POSTAGE WILL BE PAID BY ADDRESSEE

NATURAL HISTORY

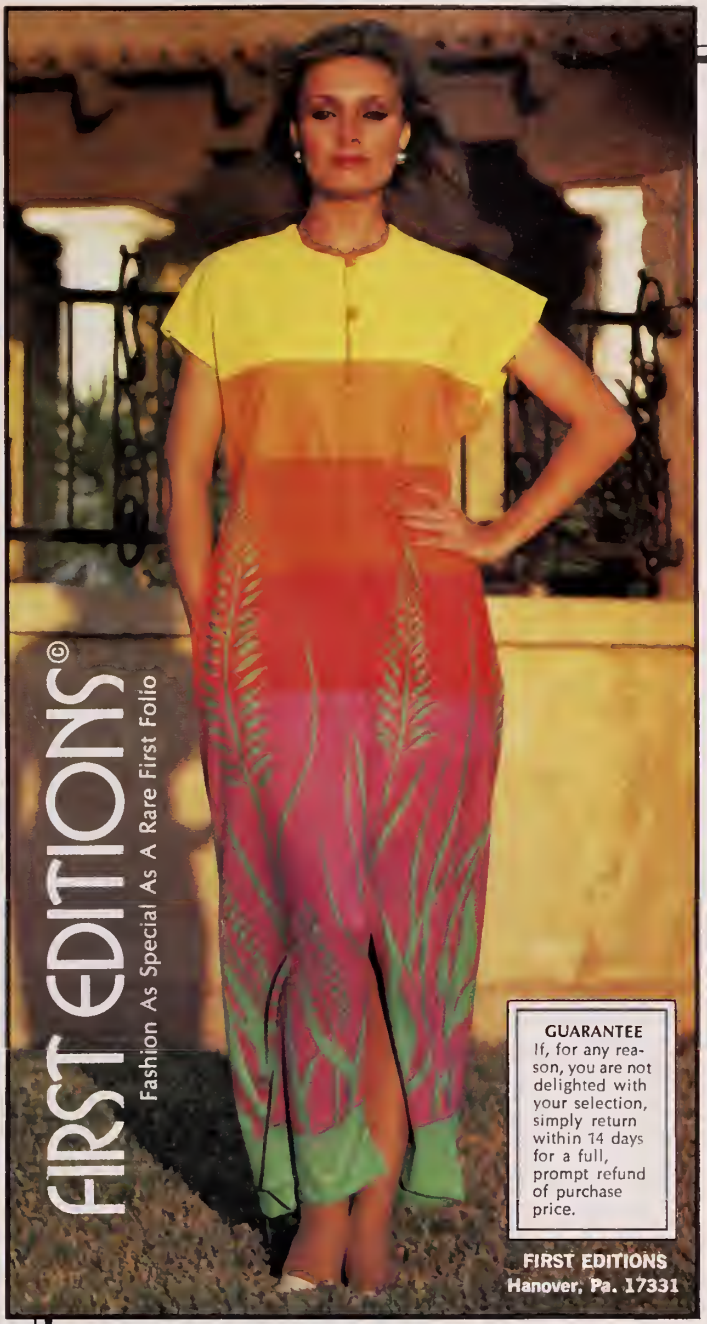
P.O. Box 4200
Bergenfield, N.J. 07621

he had no particular love for animals (and actually hated cats), was appalled at the way animals were abused. He was also impressed by the high social status of the RSPCA, and in 1866 he recruited New York's leading citizens to form the American Society for the Prevention of Cruelty to Animals. Dues were set at a high $10 a year, which only the well-off could afford. Other cities quickly followed this example. In Boston, a self-made lawyer named George Angell gained the social standing he longed for by his prodigious work in the local society. Philadelphia women, who were not allowed to hold office in that city's society, formed their own and virtually took over the protection of four-footed Philadelphians. The groups were not democratic, but they got things done.

The richness of *Reckoning with the Beast* lies in the way Turner relates the beginnings of the animal welfare movement to other social forces of the times. It was linked, both in its impulses and the people it involved, to a new Victorian temper, an emphasis on compassion that was "part and parcel," says Turner, "of the separate bundles of worries, ideas and emotions" brought on by the stunning succession of political, industrial, and scientific revolutions. The same reformers who fought to abolish slavery and the exploitation of child workers also fought to stop cruelty to animals.

But for most people who joined the movement, kindness to animals was a comfortable middle-class cause—an outlet for compassion that did not involve politics, as abolition did, or invade family rights, as child protection might. It provided, says Turner wryly, "relief from the internal discomforts involved in digesting fundamental social changes." And when the doctrines of Darwinism "raised disturbing questions about people's own animality, compassion helped quiet them."

Compassion was inevitably diluted by the Victorian genius for sentimentality. "Educate the hearts of the people and the heads will take care of



SOFT • SIZZLING • SENSATIONAL

THE GRAPHIC PRINT TERRY LOUNGER

. . . ablaze with the colors of a tropical sunset. Striped and super-imposed with flora from a fantasy rainforest. The essence of life on the easy side, with seductive slit, side-seam pocket, a trio of buttons to the front zipper. Created for casual hostessing, covering up at poolside, sipping Piña Coladas on the patio. Absolutely undemanding in washable acetate/nylon terry that packs up perfectly to follow the sun. Yellow/orange. Sizes S(8-10), M(12-14), L(16-18). (M218164) **$19.95**

FIRST EDITIONS, Dept. JM-7544, 340 Poplar Street, Hanover, Pa. 17331

Kindly send _____ Terry Lounger(s) (M218164) for just $19.95 each plus $1.50 each postage and handling.
☐ SAVE! Order TWO loungers for just $38.00 plus $2.75 pstg. & hdlg.
Size(s) and Color(s)_____
CHARGE IT: ☐ American Express ☐ Diners Club ☐ Carte Blanche ☐ Visa ☐ Master Charge
Acc't no._____ Exp. date_____
☐ Enclosed is $_____ (check or money order)

PRINT NAME_____
ADDRESS_____
CITY_____
STATE_____ ZIP_____

☐ Check here and send 50¢ for year's subscription to our catalog of fine ladies' apparel and accessories (M389858X). We ship within 48 hours; delays notified promptly. Delivery guaranteed within 60 days.

© First Editions, 1981

themselves," was the approach used to teach the common people the virtue of being kind to animals. Whatever their method, says Turner, the Victorians "did enshrine a sympathy for suffering, and not only for suffering animals, among the dominant values of Anglo-American cultures."

The sympathy found several outlets. The new fashion for pets was encouraged by Harriet Beecher Stowe's lump-in-the-throat description of a dog as "nothing but organized love, love on four feet that would die for you, yet cannot speak." A vegetarian sect called the Dorrilites settled in Vermont in the 1790s, but the mainstream of this movement had its source in the precepts of a British Swedenborgian named Cowherd whose disciples settled in Pennsylvania in 1817.

The antivivisectionists were a reaction to the paradoxical actions of science. First, scientists gave a rational base to the animal welfare movement by establishing the biological relationship between humans and beasts. Then exploited this relationship to experiment on animals in order to find cures for human ills. That brought the antivivisectionists charging in to stop the scientists in their "inhumane" acts. They accused experimenters of gothic horrors: "men of science disembowel living horses and open the brains of dogs." Compassion and goodness counted for more than knowledge, they declared, and doubted that vivisection had any use at all. Such doubts were blown away once and for all in 1894 when, after years of testing on animals, two Americans produced an antitoxin for diptheria. This not only conquered a frightening disease that killed two of every five infants that contracted it but also routed the antivivisectionists. They became more concerned—as most are today—with restricting animal experiments than with abolishing them.

Although Turner ignores the instructive role of nineteenth-century naturalists, he does pay attention to today's environmentalists, whose humane impulses, he observes, are directed at all nature, not just one part of it. Their new concern for man's place in nature, he suggests, was born "from the unlikely womb of the Victorian love for animals."

Turner does a remarkable job of encompassing his many-faceted history in a short 140 pages. His bibliographic notes run a quarter as long as his text and are, in themselves, an engrossing index to the ramifications of the subject. Out of his studies, he spins convincing analyses, although it is sometimes disconcerting to read, afterward, that they are not documented fact but considered speculation. Still, the caveats are always there, even if the pace of the book might pull the reader too quickly past them.

Turner could have paused from time to time to tell more about some of the people he presents. Queen Victoria is described as "the kingdom's most prominent antivivisectionist," and that is all we get on her. Henry Bergh's foibles are detailed but not the courage that sent him out, tophatted and armed only with a piece of paper from a judge, to stop brawny carters from lashing their horses and bloody-handed abattoir workers from mindlessly adding to the agonies of their victims. In fact, none of the unyielding dedication of the humane leaders comes through nor is it made plain that an iron rod of Christian duty reinforced Victorian sentimentality.

By design, Turner limits himself to England and America, never explaining the attitudes of other Western countries. This is not a complaint, however, but a regret. Turner's adept scholarship, his perceptions of social history, and his frequent wit make *Reckoning with the Beast* an enlivening exposition of values we take too much for granted. And the jacket of the book is, in itself, an inspired comment. It is a painting by George Stubbs of a monkey looking out at his human kin with wise and wary eyes and evoking a question: Which beast should be reckoning with which?

Joseph Kastner, a former editor of Life, *and that magazine's first nature editor, is the author of* A Species of Eternity *(Knopf), a history of early American naturalists.*



Painting by George Stubbs, Walker Art Gallery, Liverpool



Main intersection at a Hollywood oil field.

"This is the set where they shot 'Hello, Dolly!' What you can't see is us pumping oil behind it."

"One of the strangest places I ever produced oil," says Gulf Production Superintendent Eddie Culbertson, "was right here in Los Angeles, in the back lot of the 20th Century-Fox studio.

"They found an oil field right under a permanent set being used for shooting the movie 'Hello, Dolly!' in 1969.

The indirect approach

"How do you get at the oil without disturbing the set, the streets, or the buildings? With a technique called directional drilling. The oil is as far as one mile from the surface location of the drill sites, which were hidden by the scenery.



"We showed them how they could have their oil and their movies."

"Directional drilling has other advantages. You can drill 20 or 30 wells from just one drill site. Or you can drill for some offshore oil without putting the drilling rig right in the water.



"Behind the scenery are 22 producing oil wells."

Keep America beautiful

"Sometimes it's a real challenge getting the oil without spoiling the landscape. Directional drilling is one way to do it.

"But there are other ways, and at Gulf we're using all of them—doing all we can to keep supplying energy for tomorrow."

Gulf

Gulf people: energy for tomorrow.

Gulf Oil Corporation.

Olympic Trials

The native Olympia oyster of the Pacific Northwest is so rare that it is almost never seen

by Raymond Sokolov

"A loaf of bread," the Walrus said,
"Is what we chiefly need:
Pepper and vinegar besides
Are very good indeed—
Now if you're ready, Oysters dear,
We can begin to feed."
But answer came there none—
And this was scarcely odd because
They'd eaten every one.

Lewis Carroll
Through the Looking-Glass

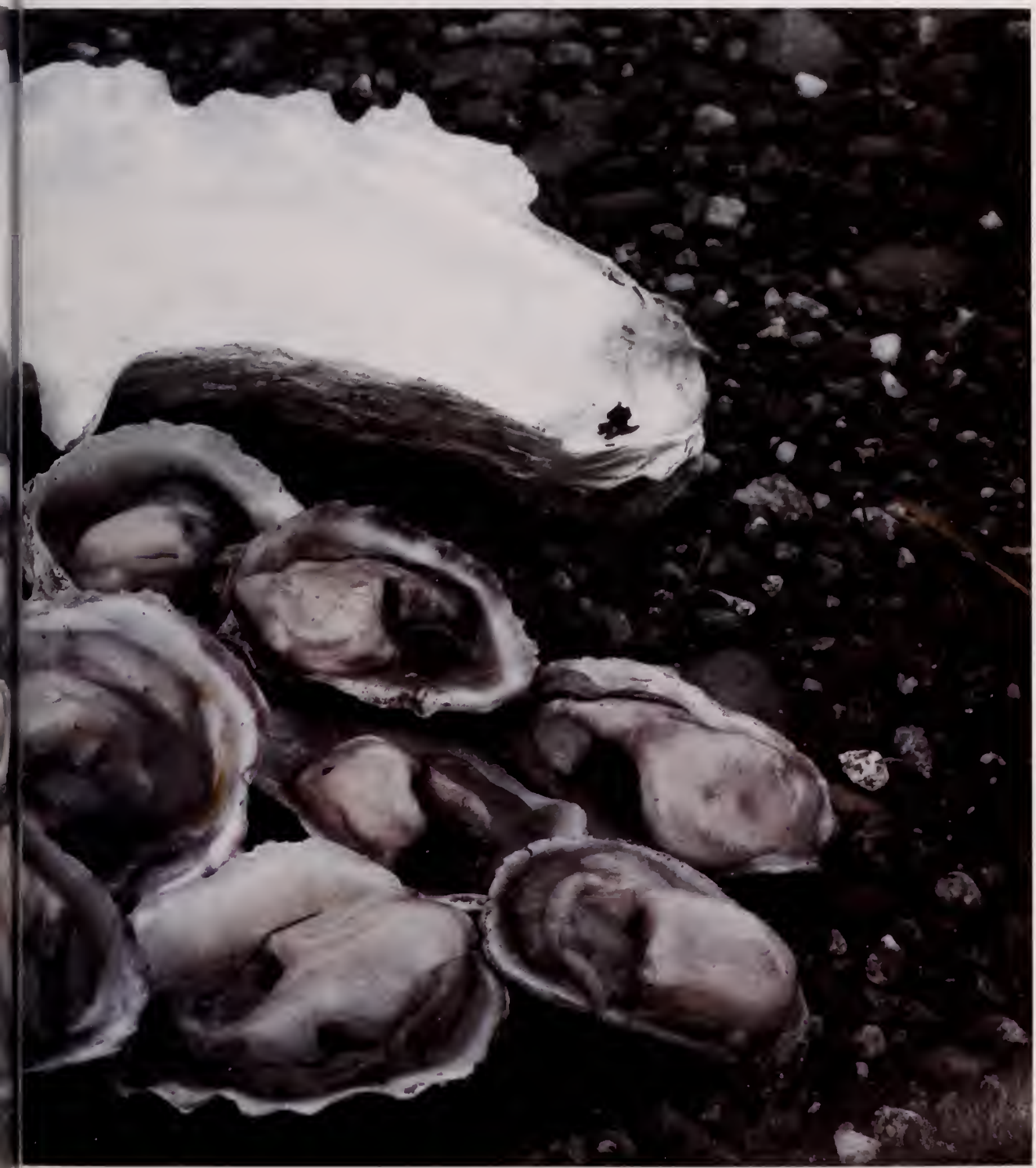
Oysters naturally just stay put, lying in their salty beds, waiting for people to eat them. As Saki put it, "There's nothing in Christianity or Buddhism that quite matches the sympathetic unselfishness of an oyster." Taking advantage of such complaisance has been a human habit since prehistoric times. And in each place where people have found abundant colonies of oysters, they have attacked them wholesale, downing dozen after dozen, until what had begun as a cheap snack for Everyman was so depleted that only the wealthy could continue to feast with traditional abandon.

In Britain today, Colchester oysters are now a luxury, but in Dickens's *Pickwick Papers* (1837), Sam Weller observes: "Poverty and oysters always seems to go together." The same process occurred in this country, where early settlers on the Atlantic coast considered oysters poor people's food, and contemporary New Yorkers pay a premium price for increasingly scarce specimens of *Crassostrea virginica*. On our Pacific coast, the situation is far worse.

The native Olympia oyster, *Ostrea lurida*, is so rare that it is almost never seen, even in the state of Wash-



Delicate "Olys" (foreground), the native Olympia oysters, are smaller and tastier than the large Pacifics that have replaced them.



Photographs by Adelaide de Menil



A large pile of oyster shells outside the Skookum Bay Oyster Company

ington, where it was once an important feature of the local economy. The tiny, 1½-inch-long bivalve, with its distinctive violet-tinged inner shell walls and intense marine taste, was a unique and toothsome part of pioneer days in the Pacific Northwest. Delicate "Olys" were the favored sweetmeat of Gold Rush San Francisco. In our ill-favored era, there are none for sale in San Francisco. Why you cannot even buy one at an oyster bar in Seattle. Instead, you find insipid Pacifics (*Crassostrea gigas*) grown locally from Japanese seed. They are huge, attaining a length of ten inches, and they grow fast. Young ones, eaten directly from the shell, do have a certain tang to them. But full-size Pacifics, shucked industrially and assiduously washed—the normal practice on the West Coast—are as flat in flavor as a hunk of wet foam rubber. Meanwhile, the elegant little Oly has all but vanished into the folklore of Puget Sound and the Northwest Coast.

James G. Swan, an early settler in the Washington Territory—and a pioneer Indian ethnographer, inveterate diarist, debauchee, and opportunist—worked in the oyster business in its infancy during three years (1852 to 1855) he spent at Shoalwater Bay. Swan, who took a precise interest in what he ate, wrote of the "strong, coppery taste" of the Shoalwater Bay oysters, which he attributed to the mud flats where they grew. "What is called a coppery taste," he went on, "is simply a strong, fishy, salt-water flavor, which, however, is driven off by cooking."

Taste changes over time, and the coppery, "fishy" taste Swan boiled or fried away is probably the taste modern oyster lovers seek. Still, it is risky to rely on descriptions of flavor from the past. After all, in his memoir of Shoalwater Bay, *Oysterville*, Willard R. Espy states that "the Puget Sound oyster, known as the Olympia, had a copper taste offensive to refined San Francisco palates. But the same gourmets who rejected the Olympia oysters sang hosannas" to the oysters of Shoalwater Bay.

Presumably, all those Northwest Pacific oysters in the middle nineteenth century were examples of *Ostrea lurida*, what we would call Olympias. Their coppery taste, or lack of it, will probably remain a subject of gastronomic confusion. There is no



doubt, however, that literally tons of oysters were consumed after gold was struck in California. San Francisco Bay was stripped bare first. And so the devastation went, on up the coast. Puget Sound was the most remote source and held out longest.

At the turn of the century, whole communities of oyster folk lived and worked on float houses in the tidal inlets of southern Puget Sound near Olympia. Steamers came daily to Mud Bay, Oyster Bay, and Little Skookum to pick up sacks of Olympias. To fill those sacks, oystermen and their families worked through the night, when the tide was usually out and the oysters could be raked from the mud flats.

Cora G. Chase spent part of her childhood, from 1898 to 1914, on a float house in Oyster Bay. In a memoir, written as a research paper at the University of Washington in 1944, she interviewed one of the pioneer oystermen, Dick Helser, an old neighbor at Oyster Bay:

> He worked his own bed in the early days, getting up at night according to the tides, raking oysters in windrows around a float that had been staked out when the tide was in, then forked them up into the float by lantern light. In the gray of cold winter mornings the loaded float was "poled" to the culling house anchored some distance from shore. There the oysters were forked into a sink float, an upside-down float holding two feet of water to keep the oysters fresh.
>
> From the sinkfloat they were forked into a wheelbarrow, rolled into the culling house, up a plank and dumped onto the culling table. All day long the cullers sorted out the larger oysters, knocking off barnacles, smaller oysters and debris with a culling iron (a thin piece of metal easily grasped) and dropping the marketable oysters into a five-gallon kerosene can, then raking the cullings down the hopper at the edge of the table.

Cheap child and nonwhite labor kept the barnacles and oyster shells flying and filled the sacks with precious mature Olympias. Many hands, chilly from long days and nights of dull work in the damp and cold, made rapid work of the depletion of Washington's natural oyster beds. By the nineties, it was necessary to construct artificial beds, diked so that water would shelter the seeded oysters from extremes of heat and cold. Chinese did the work for ten cents an hour. Today, it costs $12,000 to construct an acre of oyster beds, according to Vivian Ellison Bower of Ellison's Oyster Company outside Olympia. At that price, no one is building new beds for Olympias anymore. In fact, almost no one is even seeding the old beds anymore. "Everyone's given up," says Mrs. Bower. "It's all hand labor and takes four years."

Olympias mature slowly and never get very large. Inevitably, they have lost out to the larger Pacific oysters. The decline has gone so far that it is virtually impossible to taste an Oly without going to Olympia itself, and even there the line of supply is very thin.

The only restaurant in town (and probably the only restaurant in the world) that makes a practice of serving Olympias is the historic Olympia Oyster House. On one of the walls is a framed menu from 1921 listing an Olympia oyster stew for 30 cents. Today the restaurant's menu still lists Olympias but gives no price. Instead, in parentheses, it warns that "market" will determine the cost of the oysters, "when available."

"We used to ship them fresh anywhere," the manager told me. "Now we buy a gallon or two at a time."

For a plate of crisply fried, breaded Olympias I paid $16.95, which was fair enough for so rare an item. But all that breading and cooking had effectively removed too much of the oysters' essential flavor for me to get a true impression of their taste. I wanted freshly opened Olympias on the half shell, but the Olympia Oyster House bought them already shucked from a supplier.

Of the several oyster companies in the Olympia area, only two process Olympias. The Olympia Oyster Com-



Olys are shucked with a special scaled-down oyster knife

pany opens only three to four bushels a week and didn't happen to have any in stock when I passed through. But the Skookum Bay Oyster Company, a family operation located on a small bay in the hinterland of Shelton, Washington, at the end of a dirt road, is in its gray way a landmark of contemporary American gastronomy. It processes Olympias with regularity.

Outside the company's weathered building, you notice a derelict boat and big piles of oyster shells. Some of those piles are made of tiny, irregular, purple-tinted shells, which thousands of Olympias once lived in.

Inside, John Blanton supervises his little factory. In the first work area one comes to, a woman jabs at humongous Pacifics, flipping them out of their shells like great pale tongues. In back, Blanton's grown daughter Donna works more delicately, with a scaled-down oyster knife especially modified for Olys. Donna can open roughly 4,000 of them on an average day, about two gallons of shucked Olys altogether. Her brother culls the day's load of mud- and shell-filled pickings from the family's Olympia beds. He passes a small number of harvestable oysters on to his sister.

The scene is not quite as romantic as the floating world of Oyster Bay that Cora Chase describes. But the Blantons are certainly in the same tradition.

Donna let me fumble with her knife until I got an oyster open. Straightaway, I sucked the thumbnail-sized mollusk out of its shell.

The taste was sharply marine but also refined, and in no way did it remind me of copper. I confirmed this judgment some hours later at the place where Dungeness Spit arcs out in a thin ray of sand for miles into the Strait of Juan de Fuca. Sitting on driftwood in the perpetual drizzle, I devoured thirty or more shucked Olys, feeling favored but wondering why tradition-crazed Westerners and the Northwest Coast's rabid environmentalists haven't put their money as well as their mouths behind the preservation and encouragement of a unique, vanishing, and most toothsome native bivalve. If we are finally ready as a nation for the small car, why not also insist on our right to the small oyster?

Raymond Sokolov, a writer with an interest in the history and preparation of food, is editor of Book Digest.



Doane's Pan Roast
(Courtesy of Olympia Oyster House)

1 pint shucked oysters
2 tablespoons butter
3–4 tablespoons ketchup
Pepper
Toasted bread

1. Wash oysters well.
2. Put in a pan and let come to a simmer. Immediately add butter, ketchup, and pepper. Stir gently and serve on toasted bread as soon as butter melts.

Yield: Two servings

Lila Gault's Northwest Oyster Stew
(Adapted from *The Northwest Cookbook*; Quick Fox, Inc.)

1 pint shucked oysters
1 cup heavy cream
3 cups milk
1 teaspoon salt
1 tablespoon Worcestershire sauce
Cayenne
2 tablespoons butter
Chopped parsley

1. In a large Dutch oven, simmer oysters in their liquor over low heat for about three minutes or until the edges begin to curl. Add cream and milk, and heat until bubbles form around edge of pot, but not until boiling.
2. Add salt, Worcestershire, and cayenne in small amounts to taste.
3. Remove from heat and add butter. Garnish with chopped parsley.

Yield: Four servings

World praise for the new World Car

"...voted most significant domestic car 1981" Readers' Choice Poll.
CAR AND DRIVER, USA

"...almost a dream car..."
EXPRESSEN, SWEDEN

"The most advanced technical characteristics Ford has ever produced."
AUTO SPRINT, ITALY

"This destiny car is marvelous all around..."
BILD ZEITUNG, GERMANY

"Economical, fuel-and-space efficient... entertaining to drive..."
ROAD & TRACK, USA

"Road Test magazine's Car of the Year!"
ROAD TEST, USA

Ford engineers all around the world worked together to build a technologically advanced, economical automobile—Ford Escort, the new World Car.

44 EST HWY* (30) EPA EST MPG*

*Applies only to sedans without power steering or A/C. For comparison. Your mileage may differ depending on speed, distance, weather. Actual hwy mileage and Calif. ratings lower. Excludes diesels.

Now, both the American and the overseas versions are winning accolades from automotive experts in their countries.

And no wonder. The compact Escort has front-wheel drive, a new-design hemispherical head engine, 4-wheel independent suspension, and better gas mileage ratings than subcompacts like VW Rabbit, Honda Accord, Toyota Corolla Hatchback.

See it at your Ford dealers.

Built to take on the world... and doing it!



THE TASTE BEYOND 12-YEAR-OLD SCOTCH



Discover more.

Let your mature taste lead you from the finest premium Scotch on up to the most expensive 12-year-old Scotch in the world. The Glenlivet. The ultimate in Scotch.

Most premium Scotch is blended and depends on several whiskies for taste and smoothness.

Yet the unblended character of The Glenlivet is noble enough to stand alone. In this distinctive Scotch whisky you'll experience an exceptional smoothness and full-bodied richness, unmatched in all other premium Scotch.

Try the taste beyond premium Scotch.

The Glenlivet
Unchanged since 1824.

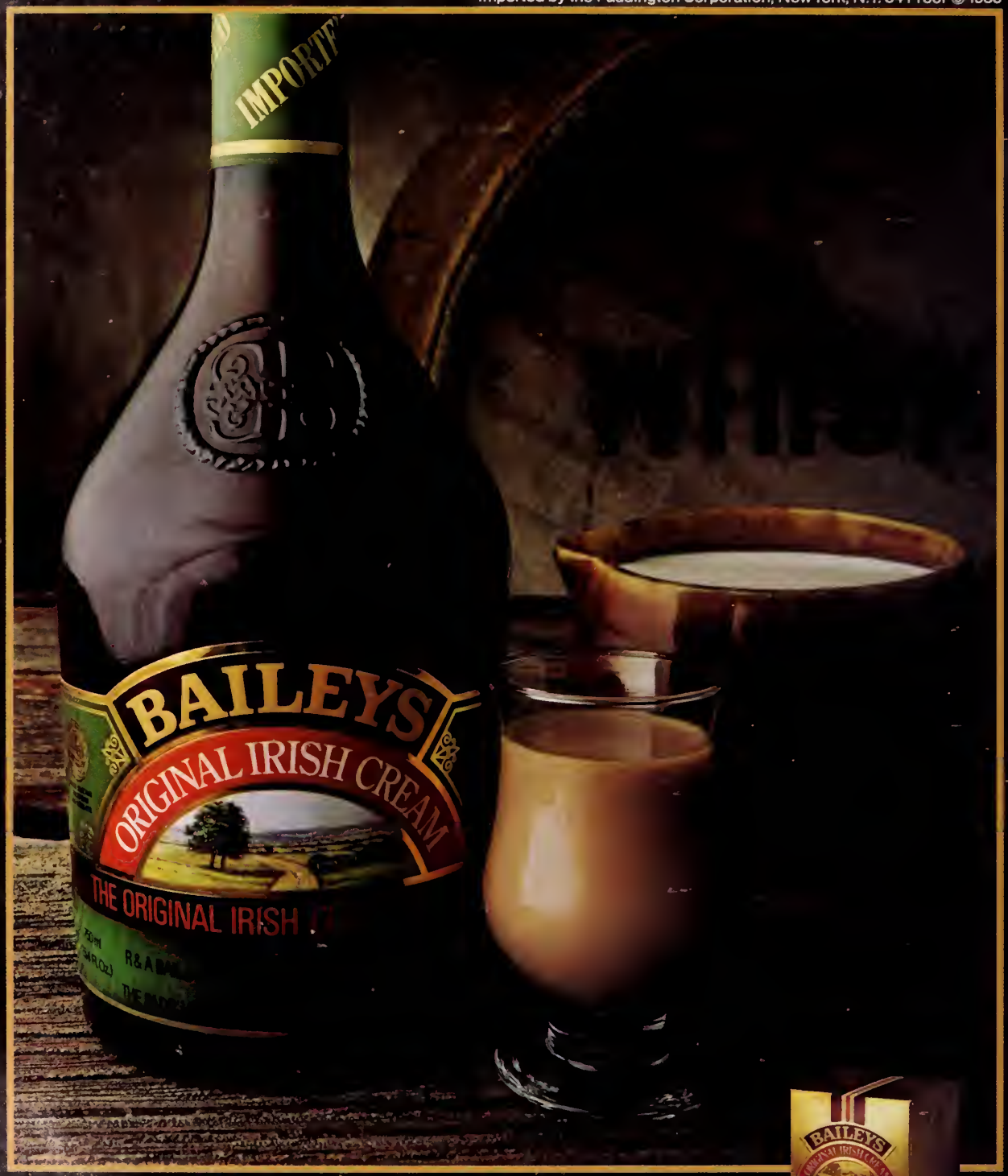
5.66(747)M1 Ref.

NATURAL HISTORY



6/81

Imported by the Paddington Corporation, New York, N.Y. 34 Proof © 1980



BAILEYS.
THE ORIGINAL IRISH CREAM LIQUEUR.

THE CREAM IS REAL. THE WHISKEY IS REAL.
ONLY THE TASTE IS MAGIC!

NATURAL HISTORY

Vol. 90, No. 6, June 1981

American Museum of Natural History
Robert G. Goelet, President
Thomas D. Nicholson, Director

Alan Ternes, Editor
Judith Friedman, Managing Editor
Thomas Page, Designer
Board of Editors:
Sally Lindsay, Frederick Hartmann, Vittorio Maestro, Rebecca B. Finnell
Carol Breslin, Book Reviews Editor
Florence G. Edelstein, Copy Chief
Rita Campon, Copy Editor
Angela Soccodato, Art Asst.
Kay Zakariasen, Picture Editor
Douglas J. Preston, Publications Editor
Susan Rosenberg, Editorial Asst.
Lillian Berger
Editorial Advisers:
Malcolm Arth, James W. Atz, Niles Eldredge, Kenneth L. Franklin, E.Craig Morris, Norman Newell, Thomas D. Nicholson, Martin Prinz, Gerard Piel, Nina Root

David D. Ryus, Publisher
Bradford D. Smith, Business Manager
Frederick E. Grossman, Production Mgr.
Debra Buck McCord, Asst. Production Mgr.
Ernestine Weindorf, Administrative Asst.
Elaine M. Callender, Advtg. Production Mgr.
Lauren Krenzel

Daniel J. Dynan, Asst. Circulation Mgr.
Bob Bruno, Fulfillment Mgr.
Ramón E. Alvarez, Circulation Asst.

NATURAL HISTORY *(ISSN 0028-0712), incorporating Nature Magazine, is published monthly by the American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024. Subscriptions: $15.00 a year. In Canada and all other countries: $18.00 a year. Second-class postage paid at New York, N.Y. and at additional offices.*

Copyright © 1981 by American Museum of Natural History. All rights reserved. No part of this periodical may be reproduced without written consent of Natural History. *The opinions expressed by authors do not necessarily reflect the policy of the American Museum.*

Natural History *is indexed in* Reader's Guide to Periodical Literature.

Advertising Offices:
Natural History Sales
488 Madison Avenue
New York, N.Y. 10022
President of Sales, Arthur Hill Diedrick
Advertising Manager, Katherine José

Telephone Numbers:
Advertising Sales (212) 826-9467
Museum Information (212) 873-4225
Subscription Orders (800) 247-5470
(800) 532-1272 (in Iowa)

Change of address notices, undeliverable copies, orders for subscriptions, and other mail items are to be sent to
Natural History Membership Services
Box 4300
Bergenfield, New Jersey 07621

2 Authors

4 The Flood of Antievolutionism *Laurie R. Godfrey*
"Scientific creationism may be poor science, but it is powerful politics."

12 This View of Life *Stephen Jay Gould*
Piltdown in Letters

32 The Virtue of Forests, Virgin and Otherwise *Hazel R. Delcourt*
The rise and fall of forests may have a worldwide impact on climate.

40 Spain's Imperial Eagle *Photographs by José Luis González Grande*
A magnificent endangered bird raises its next generation.

44 Young Traders of Northern Nigeria *Enid Schildkrout*
If Western customs of child education are followed, the economic workings of a culture will be undermined.

54 Shakespeare—The Poet's Worlds *S. Schoenbaum*
Town and country life permeated his works, as seen in a special Museum exhibition.

60 Peaceable Peccaries *John A. Byers*
With play and tolerance for young—plus a lot of grunts and rubs—these animals lead a most sociable life.

70 Sky Reporter *James W. Christy*
Searching for Dim Companions

74 Celestial Events *Thomas D. Nicholson*

76 Books in Review *Boyce Rensberger*
The Wildest of All Wild Places

82 Additional Reading

84 At the American Museum
Faces from the Past

88 A Matter of Taste *Raymond Sokolov*
The Lime That Failed

Cover: *The stork is one of the birds represented in French naturalist Pierre Belon's* L'Histoire de la Nature des Oyseaux, *published in 1555. This book and other selections from the Folger Shakespeare Library will be shown at the American Museum from June 18 to September 20 in a special exhibit, "Shakespeare: The Globe & the World." Story on page 54.*

After analyzing land surveyors' notes, U.S. Bureau of the Census statistics, and inventory records from the U.S. Forest Service, **Hazel R. Delcourt** was able to reconstruct the changing patterns of land use and carbon storage in the Southeast over the past 250 years. She has recently expanded her work to include all of the eastern United States. A research associate at Oak Ridge National Laboratory in Tennessee, Delcourt also pursues her interest in vegetational and climatic change through the study of pollen and plant macrofossils preserved in the sediments of lakes and bogs. Together with her husband, Paul, she hopes in the future to calibrate "modern forest composition with atmospheric pollen samples in order to reconstruct forest history in the eastern United States for the past 20,000 years."



While studying migration and ethnicity in Ghana, **Enid Schildkrout** (right) noticed that to assist them in their home industries, women often decided to raise children who were not their own and that women earned more when they had such children to help them. Having learned the Hausa language in Ghana, she set out for northern Nigeria in 1976 to explore the economic roles of women and children more deeply. Schildkrout holds a doctorate in social anthropology from Cambridge University and is the author of *People of the Zongo: The Transformation of Ethnic Identities in Ghana.* Since 1973 she has been an associate curator in the American Museum's Department of Anthropology.



When the Folger Shakespeare Library in Washington, D. C., decided to mount a traveling exhibition drawn from its wide-ranging collection of materials related to the Bard of Avon and his age, Shakespeare scholar **Sam Schoenbaum** was given the task of writing an accompanying catalog. Although it meant delving into subjects with which he could "claim only amateur status"—such as the flora and fauna of Warwickshire—Schoenbaum took on the assignment with enthusiasm. "I was here given occasion to study many unique items for the first time," he comments in the catalog's preface. "Meanwhile, the books and manuscripts already long familiar to me retained their magic; the honeymoon is still on." Distinguished Professor of Renaissance Literature at the University of Maryland, Schoenbaum is currently coediting the *Complete Oxford Shakespeare.* The article in *Natural History* is adapted from his Folger exhibit catalog.





John A. Byers, an assistant professor of zoology at the University of Idaho, writes that his interest in peccaries began in 1976. He had been studying play in Siberian ibex at the Brookfield Zoo in Chicago. The peccary enclosure was near the ibex exhibit, he says, and the peccaries caught his eye: "I did some reading about them and realized that very little was known about their social behavior. There were fascinating hints in the literature suggesting that peccaries were highly social and this led me into my fieldwork in Arizona." Byers is now beginning a five-year project on the relationship between variation in behavioral development and subsequent variation in reproductive success in pronghorn antelopes. The research will be done at the National Bison Range in Montana. Byers enjoys Eastern European novels and beer, and says that he is tired of people sending him items with pig motifs.



The next picture you take with your 35mm SLR can be as creative as any of these.

With the most creative new idea in photography.

The Cokin Creative Filter System is a totally new way to perform creative miracles using any 35mm SLR: Canon, Leica, Minolta, Nikon, Olympus, Pentax and others. And it's easy, too. Send a dollar for the full-color Cokin guide with 158 stunning examples of the imaginative effects you can achieve. Please allow four to six weeks for delivery.



Cokin® Creative Filter System
Minolta Corp., P.O. Box 600, Garden City, N.Y. 11530

Here's my check or money order for one dollar, made payable to Minolta Corporation. Please send me your 40-page, full-color guide to the Cokin Creative Filter System.

Name (Please print)_____

Address_____

City_____ State_____ Zip_____

cokin®
Creative Filter System
Marketed by Minolta Corporation

NH-6

The Flood of Antievolutionism

Where is the science in "scientific creationism"?

by Laurie R. Godfrey

In 1963, American historian Richard Hofstadter wrote that "today the evolutionary controversy seems as remote as the Homeric era." The Biological Sciences Curriculum Study Project, supported in part by federal funds, was preparing secondary school texts that openly presented evolution as the foundation of biology. And George McCready Price, an outspoken leader of the protest against evolution in the days of the Scopes "monkey trial" and author of numerous antievolutionary tomes, including *The Phantom of Organic Evolution* (1924), *A History of Some Scientific Blunders* (1930), *The Modern Flood Theory of Geology* (1935), and *Genesis Vindicated* (1941), died at the age of 92. But 1963 was also the year that the Creation Research Society—and with it, organized "scientific creationism"—was born.

The Creation Research Society was founded by a group of ten men led by Walter E. Lammerts and William J. Tinkle. Many of these men were disaffected members of the American Scientific Affiliation, a theistic organization founded in 1941 and devoted to the reconciliation of science and evangelical Christianity. The increasing domination of the organization by evolutionists disturbed those who wanted it to oppose evolutionism. The "team of ten" vowed to work, through what they regarded as scientific endeavors, for a revival of belief in special creation as described in the King James version of the Bible. While they held populist William Jennings Bryan, the Scopes prosecutor, in high esteem, the new activists were creationists of a different ilk.

Bryan had mocked his scientific opponents: "You believe in the age of rocks; I believe in the Rock of Ages." He had preached to the masses, "I would rather begin with God and reason down then begin with a piece of dirt and reason up." But the new creationists profess no disdain for science. College-educated fundamentalist Christians with a strong commitment to both science (particularly in the form of technology and engineering) and to a literal interpretation of the Bible, they have set out to convince the public that "true science" supports the creation model of world and life origins. Denying that they are trying to bring religion into the public schools, they are seeking to have their model taught as science.

By the end of 1980, seventeen years after Hofstadter had pronounced the evolution controversy dead, "two-model" scientific education bills—which would require public schools to present creation as a scientific model alongside evolution—had been introduced and debated in the state legislatures of Florida, Georgia, Illinois, Iowa, Kentucky, Louisiana, Minnesota, New York, South Carolina, Tennessee, and Washington and were being introduced elsewhere. In addition, various local school boards around the country had passed resolutions that made concessions to creationist pressure. The membership of the Creation Research Society, based in Ann Arbor, had grown to 2,500. Sister organizations such as the Bible Science Association (Minneapolis), the Creation Social Science and Humanities Society (Wichita), the Institute for Creation Research and the Creation Science Research Center (San Diego) had been formed to defend scientific creationism and promote the teaching of creation as equal with evolution.

Led by virtually the same nucleus of antievolutionists, these organizations have become efficient factories of purportedly scientific antievolutionary propaganda. Conventions, as well as debates, textbooks, and films, are the means to the political end of building a constituency. The Institute for Creation Research (ICR) now offers college- and graduate-level programs as well as summer institutes (offering optional college credit) on creationism; distributes antievolutionary books, pamphlets, and cassettes; and sponsors creation/evolution debates and nationally distributed weekly radio broadcasts. And the ICR also funds research: to find evidence of Noah's ark and a global flood; evidence of coexisting humans, trilobites, and dinosaurs; and proof of a recent creation of the universe and the planet Earth (the earth is assumed to be roughly 10,000 years old). The Creation Research Society developed the first "creation science" biology textbook meant for use in public secondary schools, and since 1964 the society has published a quarterly journal dealing with evidence that supports a literal interpretation of the Bible.

The scientific creationists make no attempt to hide the proselytizing role of their various research organizations. Emphasis Creation 1980 was a Midwestern convention of scientific creationists sponsored jointly by the ICR and the Bible Science Association. The Director of the ICR, Henry Morris, gave explicit instructions, which appeared in the newsletter of the ICR's Midwest Center:

Roam the world with ease

Now MasterCard™ Travelers Cheques.

Now a Travelers Cheque
bears the MasterCard symbol.
Respected, recognized and accepted the
world over. Refundable and replaceable
twenty-four hours a day, so you can travel
truly care-free.
Next trip, roam the world with ease, with the wind
at your back. Ask for MasterCard Travelers Cheques.
Next trip,
Run With the Wind.



The purpose of such a convention should not be to provide a forum where various creationists get together to present papers arguing for their own particular interpretations on details of science or Scripture. Rather, it should seek to reach as large and general an audience as possible with carefully chosen papers (and other activities) by qualified speakers who will make the greatest impact for the creationist cause in general.

The newsletter went on to list acceptable and unacceptable topics. The former included refutations of evolutionism; legal, political, and educational aspects of teaching creation in schools; scientific evidence for a recent creation of the earth and universe; and "flood geology," which attributes a wide range of fossil-bearing geologic deposits to a single catastrophic global event, the Noachian deluge. Unacceptable topics included plate tectonics and continental drift (listed among others as areas of questionable or peripheral significance to creationism) and all "highly technical and specialized treatments of individual problems."

Field or laboratory research represents a very minor charge of scientific creationists. Most efforts are directed toward rewriting the discoveries and interpretations of evolutionists. In this endeavor, numerous evolutionists are portrayed as scientists who have all the evidence to disprove evolution (and support creation) at their fingertips, but who are either too stubborn or too deeply indoctrinated in evolutionary dogma to appreciate it. Arguments of anthropologists, biologists, chemists, geologists, astronomers, physicists, and engineers are reinterpreted or taken out of context. In this way, as I will show below, creationists manage, among other things, to convert arguments about the pattern and process of evolutionary change into arguments about the existence of change.

The primary tactic of the scientific creationists is to find controversy, disagreement, and weakness in evolutionary theory—by no means a difficult task. Having demonstrated problems with various aspects of evolutionary theory (some fabricated, some real), the creationists then conclude that we must accept the Judeo-Christian biblical account of creation as the only possible, logical alternative. Thus scientific creationism proceeds by constructing an artificial dichotomy between two models—evolution and creation—both incorrectly represented as monolithic.

Actually, various evolutionary explanations are possible, and numerous models, both Darwinian and non-Darwinian, have been posed. They have in common the notion that the earth's life forms are related by common ancestry, whether or not they have since achieved reproductive isolation. Evolutionists agree that the evidence supports this premise of genetic continuity although, as scientists, they do not rule out the logical possibility that life could have arisen independently on more than one occasion on the earth or in the universe.

Creationism, on the other hand, is based on the idea that reproductive isolation usually signals the absence of common ancestry. Given genetic discontinuity, numerous creation-based explanations are nevertheless possible: witness the global diversity of creation myths. Ignoring this diversity, however, scientific creationists begin with one specific and detailed explanation of the universe and require its acceptance on faith as a prerequisite of membership in their various research organizations. The Statement of Belief of the Creation Research Society begins: "The Bible is the written Word of God, and because we believe it to be inspired throughout, all of its assertions are historically and scientifically true in all of the original autographs." The scientific creationists do not pose and test alternative creation models. Doing science is not the business of scientific creationists; destroying the public credibility of evolution is their real goal. "New evidence," the press is told, reveals "major weaknesses" in evolution. Oddly, the creationist tactic of discovering controversies within evolutionary biology amounts to discovering that evolutionary biologists are guilty of doing science—posing, testing, and debating alternative explanations.

One scientific debate in particular, that between the neocatastrophists (or punctuationalists) and the phyletic gradualists, has fueled the fires of scientific creationism. In 1972 Niles Eldredge of the American Museum of Natural History and Harvard paleontologist Stephen Jay Gould launched their new theory of evolution by "punctuated equilibria." Evolution, they claimed, proceeds by rapid fits and starts, punctuating long periods of relative stasis. Drawing from the work of other paleontologists and neontologists, Eldredge, Gould, and later, Steven Stanley of Johns Hopkins developed the implications of a punctuational model of evolutionary change. In so doing, they challenged the assumption that most evolutionary change occurs as a byproduct of slow, ceaseless natural selection acting on variation in well-established populations.

While they have not abandoned the concept of natural selection as an important evolutionary process, the punctuationalists have reinterpreted its role. Central to their argument is the view that most evolutionary change occurs in association with speciation, that is, the formation of independent species by the splitting of lineages into reproductively isolated populations. They argue that speciation may be achieved rapidly in small, geographically isolated populations and that, in such populations, chance (as well as natural selection) can exert much greater influence on genetic change in form than is otherwise possible. They further argue that rapid or dramatic evolutionary changes cannot occur in the *absence* of speciation. The mechanisms and im-

WHEN YOU WRITE TO NATURAL HISTORY

about a change of address, renewal of subscription, billing, or any kind of adjustment, send the present address label from the magazine wrapper.

Moving? Please notify 6 weeks in advance. You can use this form to tell us about a move or order a subscription.

Change of address—Attach your address label in the dotted area and fill in your new address below, clip and mail to Natural History Membership Services, P.O. Box 4300, Bergenfield, N.J. 07621.

Cut your old address label from magazine wrapper and attach over this area.
Fill in your NEW address and mail to:
Natural History Magazine
Membership Services P.O. Box 4300
Bergenfield, N.J. 07621

PLEASE PRINT

Name _____

New Address _____

City _____ State _____ Zip _____



From more than 1000 years of tradition and art . . .

The Treasures of the Imperial Dynasties

MINIATURE VASE COLLECTION

Twelve exquisite miniature vases, re-creating the great porcelain artistry of the Chinese Imperial Dynasties.

A limited edition. Subscription deadline: June 30, 1981.

Imagine a collection of delicate and beautiful vases—authentic re-creations of historic Chinese porcelain designs. Imagine each one a fine miniature, approximately 3" high, and you have a collection to attract the admiration of all who see it.

Now *you* can own *just* such a collection. Twelve exquisite vases reflecting a thousand years of Chinese porcelain art. And, despite the careful craftsmanship involved, the price for each vase is just $12.50.

A treasury of classic porcelain art

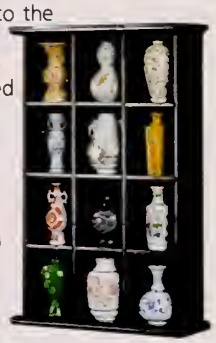
Displayed together on the black hardwood shelf provided, the 12 vases form a veritable treasury of porcelain art. A Mei-p'ing vase, in the style of the early Sung Dynasty, when only the Chinese knew the secret of making fine porcelain. A handsome temple vase, one of the earliest examples of blue-and-white ware. With ten others just as beautiful, each crafted in fine porcelain. And to ensure the *highest* standards of quality, Franklin Porcelain has entrusted crafting of the vases to its Tokyo subsidiary.

VASES SHOWN SLIGHTLY SMALLER THAN ACTUAL SIZE

A collection to grace any room in your home

Each vase represents a different era, yet each complements the others, to form a collection fascinating in its diversity. It's as though you personally searched the world's antique marts and assembled this collection piece by piece.

To acquire this intriguing collection, you need send no money now. Please note, however, that it is a limited edition available only until the end of 1981. The total edition will be forever limited to the exact number of valid applications postmarked in this period. But remember: the form below is valid only if mailed by the subscription deadline: June 30, 1981.



© 1981 FP

SUBSCRIPTION APPLICATION

THE TREASURES OF THE IMPERIAL DYNASTIES

Valid only if postmarked by June 30, 1981.

Franklin Porcelain
Franklin Center, Pennsylvania 19091

Please enter my subscription for The Treasures of the Imperial Dynasties Miniature Vase Collection: Twelve fine porcelain miniature vases, plus a handsome black hardwood display shelf at no additional charge.

I need send no money now. My vases will be sent to me at the convenient rate of one per month. I will be billed just $12.50* for each new vase in advance of its shipment.

*Plus my state sales tax and $1 shipping and handling per vase.

Signature _____
ALL APPLICATIONS ARE SUBJECT TO ACCEPTANCE

Mr.
Mrs
Ms. _____
PLEASE PRINT CLEARLY

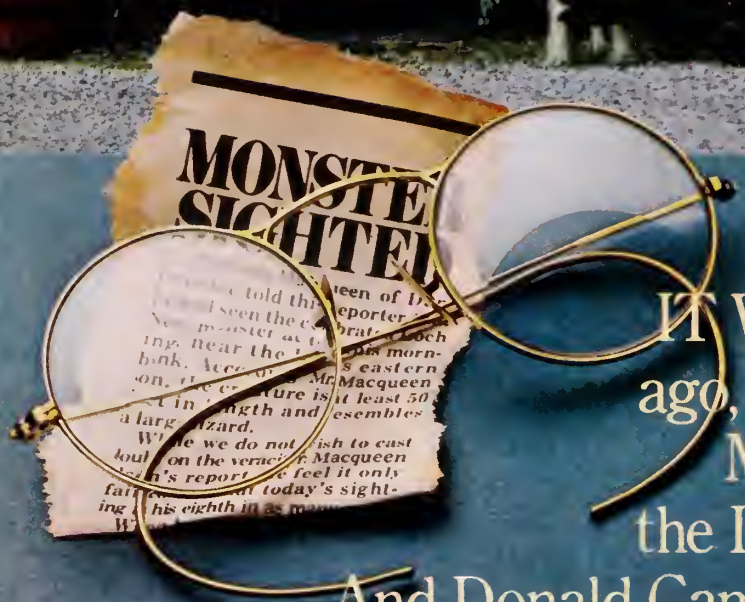
Address _____

City _____

State _____ Zip _____

Limit: One collection per person.





IT WAS seventeen years ago, in August, that Norman Macqueen says he saw the Loch Ness monster. And Donald Campbell still says he didn't.

The good things in life stay that way. Dewar's® never varies.



Authentic.
The Dewar Highlander

BLENDED SCOTCH WHISKY • 86.8 PROOF • © 1981 SCHENLEY IMPORTS CO., N.Y., N.Y.

portance of speciation lie at the heart of the debate between the punctuationalists and their opponents. Unlike the phyletic gradualists, the punctuationalists conclude that in macroevolution (evolution viewed in the long range and on a large scale), an episodic pattern of change is the expectation, rather than an exception to the rule.

A second important issue in evolution that has attracted the attention of creationists is the question of the relative importance of chance as a factor in evolutionary change. Using computer simulations, David Raup and his colleagues at Chicago's Field Museum of Natural History have argued that chance is very important in macroevolution as well as microevolution. Raup believes that many genetic changes that do not greatly affect "fitness" may survive or fail to survive owing to chance. Such evolution by chance is called neutral, or non-Darwinian, evolution. The debate in evolutionary biology is over its relative importance, not its existence.

It is hard to imagine creationists drawn to the arguments of Eldredge, Gould, and Raup, since they are antithetical to creationist tenets. First, the question of the genetics of speciation, which is central to the theory of the punctuationalist school, is foreign to creationism. "Speciation" is rarely part of creationist vocabulary; "special creation" is used instead. Creationists claim that each life form was created as a separate "kind" (a common-sensical, undefined concept) and that nature permits variation only within such created kinds. Thus they must ignore a large body of biological data on the mechanisms of speciation and examples of its occurrence observed both in the laboratory and the field. Scientific creationists deny the existence of the very process that punctuationalists argue is critical to evolutionary change.

Nothing about punctuationalism supports the creationist viewpoint. Punctuationalists simply maintain that while much evolutionary change is very slow or static, very rapid "jumps" can occur naturally and these are the important stuff of macroevolutionary change. Genetically, such jumps are as comprehensible as slow phyletic changes. Indeed, whether they are perceived as jumps at all depends upon one's expectations concerning the scale and pace of evolutionary change. As Gould has written (*Natural History*, August 1979):

> New species usually arise, not by the slow and steady transformation of entire ancestral populations, but by the splitting off of small populations from an unaltered ancestral stock. The frequency and speed of such speciation is among the hottest topics in evolutionary theory today, but I think that most of my colleagues would advocate ranges of hundreds or thousands of years for the origin of most species by splitting. This may seem like a long time in the framework of our lives, but it is a geologic instant, usually represented in the fossil record by a single bedding plane, not a long stratigraphic sequence.

Second, "chance" is also foreign to creationism. One Florida-based organization puts out a flier that reflects the widespread creationist notion that nothing (or nearly nothing) ever happens by chance: "Evolution demands what has not, and cannot happen, even with careful planning—much less by total accident!" It is, of course, a misstatement of evolution to claim that this body of theory argues that change comes about "by total accident," for selection is not a random process. Yet, the non-Darwinian school ascribes to chance a much more central role than is admitted by other evolutionary biologists. Ironically, in their effort to show disagreement among evolutionists, the creationists are citing the work of paleontologists whose arguments are, in many ways, the most antithetical to creationism.

One reason creationists are able to exploit the current debates among evolutionists is that certain key phrases have entirely different meanings for paleontologists and for creationists (or their constituency). When such phrases are lifted from the work of evolutionists and inserted into creationist literature, they acquire new meaning simply because of differences in assumed knowledge. For example, the "neocatastrophism" of paleontology (widely quoted in support of creationist catastrophism) has nothing to do with either creation or a great flood. But creationists automatically associate the term "catastrophism" with the concept of the Noachian deluge.

Creationist Gary Parker wrote an essay on neocatastrophism that was circulated in the October 1980 issue of *Acts and Facts*, the free monthly newsletter of the ICR. Reading his article one cannot avoid the conclusion that Raup and Gould consider the creation model tenable, if not actually preferable to evolutionism. Here is a passage from Parker's essay:

> "Well, we are now about 120 years after Darwin," writes David Raup of Chicago's famous Field Museum, "and the knowledge of the fossil record has been greatly expanded." [Parker cites a 1979 article by Raup.] Did this wealth of new data produce the "missing links" the Darwinists hoped to find? ". . . ironically," says Raup, "we have even fewer examples of evolutionary transition than we had in Darwin's time. By this I mean that some of the classic cases of darwinian change in the fossil record, such as the evolution of the horse in North America, have had to be discarded or modified as a result of more detailed information." Rather than forging links in the hypothetical evolutionary chain, the wealth of fossil data has served to sharpen the boundaries between the created kinds. As Gould says, our ability to classify both living and fossil species distinctly and using the same criteria "fit splendidly with creationist tenets." "But how," he asks, "could a division of the organic world into discrete entities be justified by an evolutionary theory that proclaimed ceaseless change as the fundamental fact of nature?" [Parker cites a 1979 *Natural History* article by Gould.] ". . . we still have a record which *does* show change," says Raup, "but one that can hardly be looked upon as the most reasonable consequence of natural selection." The change we see is simply variation within the created kinds, plus extinction.

The arguments Parker presents outside, as well as inside, quotation marks seem to be those of Raup and Gould. Given these selected tidbits, there is no way to interpret the statements of Raup and Gould except within the framework of the creation model. The reader is not told what Raup and Gould are arguing but is left instead to surmise, incorrectly, that evolution itself is under attack. Furthermore, Parker has chosen to cite titles that seem to support such an interpretation. Raup's article is called "Conflicts between Darwin and Paleontology." Gould's is entitled "A Quahog Is a Quahog."

Those familiar with Raup's research will not be surprised to find that his article is actually a treatise concerning problems with Darwinian gradualism. Raup first deals with the complex, uneven record of evolutionary change. His point, quoted more fully, is that "some of the classic cases of darwinian change in the fossil record, such as the evolution of the horse in North America, have had to be discarded or modified as a result of more detailed information—what appeared to be a nice simple progression when rel-

Collector's Find!



SOLID BRASS UNICORN

The stuff that dreams and songs and legends are made of . . . a magical unicorn, captured in gleaming, solid brass. Magnificently detailed . . . so real, you can almost hear him breathe. This mythical creature, discovered in a long-ago, far-away garden, symbolizes purity and innocence—and good fortune to anyone who catches one. An enchanting objet d'art for display shelf, executive desk, mantel, boudoir . . . Splendid gift for collectors of things bright and beautiful. A majestic 8" tall with protective felt base. *Brass Unicorn* (Z644559) Only $19.99 + $2.00 P&H. 2 for $38.00 + $3.50 P&H. FULLY GUARANTEED. PA Residents add Sales Tax.

PENNSYLVANIA STATION, Dept. PZ-8638
340 Poplar St., Hanover, PA 17331

L.L.Bean®
Outdoor Sporting Specialties



Summer Weight Slacks $15.50

Cool and comfortable slacks for warm weather wear. Long wearing, light weight poplin of 65% Dacron® polyester, 35% combed cotton. Washable, no ironing required. Plain front style with two front and two hip pockets. Well tailored for a comfortable trim fit.

Three colors, Lt. Green, Lt. Blue, Tan. Even waist sizes 30 to 46. Inseams 29", 31", 33"

Please Ship Postage Paid
_____Summer Weight Slacks @ $15.50
Color_____, Size_____, Inseam_____
☐ Check Enclosed ☐ Master Card
☐ VISA ☐ American Express
Card Number _____
☐ SEND FREE CATALOG Exp. Date _____
Name _____
Address _____
City _____
State_____ Zip_____

L. L. Bean, Inc.
731 Casco St., Freeport, ME 04033

atively few data were available now appears to be much more complex and much less gradualistic." Raup goes on to discuss the potential of chance processes to bring about apparently patterned evolutionary change—in particular, the extinction of lineages.

Gould's article is also about problems with Darwinian gradualism. It takes to task those biologists and anthropologists who argue that species boundaries are artifacts of the human capacity to classify and construct artificial divisions. Gould argues, as Ernst Mayr did years before, that species are real biological entities, but he does not suggest that they are genealogically unrelated to one another or that they cannot give rise to new species.

Despite the attempts of scientific creationists to play up the signs of controversy among evolutionists, there is actually widespread agreement in scientific circles that the evidence overwhelmingly supports evolutionism. Confirmation has sometimes taken unexpected forms, as in the high correlation between the degree of biochemical difference between pairs of species and the amount of paleontological time since their apparent separation.

There is agreement that the pattern of origin of taxa in the paleontological record strongly supports genetic continuity and, therefore, evolution. The punctuationalists' concept of evolutionary stasis has been misused by creationists to argue against such a pattern, but evolutionary stasis contradicts only strict gradualism, not evolution. The fact is, the genus *Homo* does not occur in the Mesozoic alongside brontosaurus, as the creationists claim; if it did, we would indeed have to question our evolutionary assumptions.

Scientists do ask questions about the pattern of evolutionary change. In particular, does the fossil record bear witness to the slow, continuous, gradual change envisioned by Darwin and supported by neo-Darwinists? Although still a matter of considerable debate, some form of punctuationalism is gaining increasing support among evolutionists. Scientists also ask questions about the process or mechanism of evolutionary change: for example, given a pattern of punctuational change, is Darwinian natural selection the best explanation for macroevolutionary trends?

The current debate is complicated because the concept of natural selection embraced by Darwinians has changed with the introduction of population genetics. Steven Stanley's concept of species selection (the differential survival of species) is part of natural selection as formulated by Darwin and some modern biologists, but not as formulated by population geneticists focusing on selection operating within populations. Therefore, when Eldredge, Gould, and Stanley proclaim natural selection to be an inadequate explanation of macroevolutionary change, it is important to realize that they are talking about natural selection as mathematized, reformulated, and restricted to populational variation by population geneticists in the 1930s.

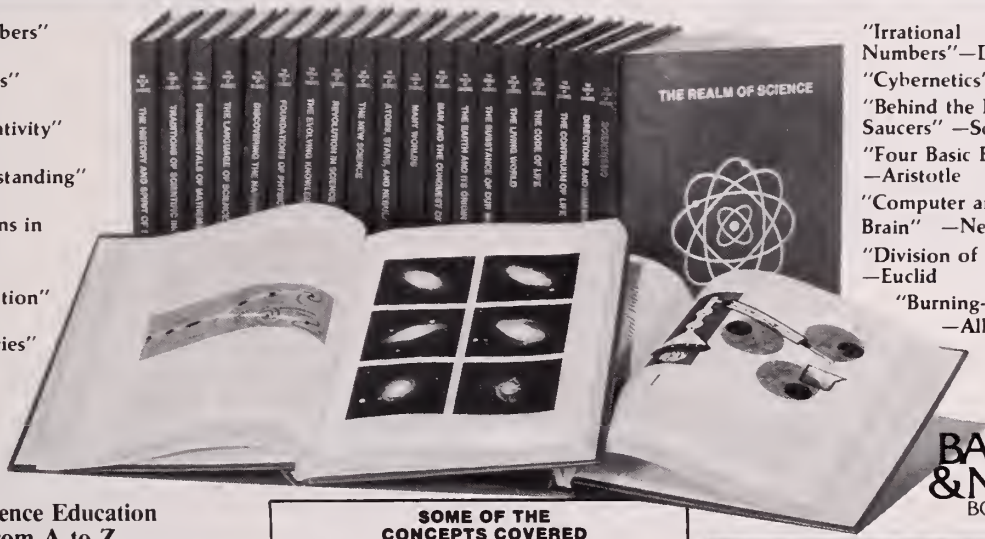
When a creationist such as Parker describes the putative failure of natural selection, however, it is to an audience that simplistically equates natural selection with evolution—an audience that does not know the difference between natural selection and species selection. Most students of scientific creationism know little about the debate between the phyletic gradualists and punctuationalists or that between proponents of Darwinian (nonrandom) and non-Darwinian (random) processes of change. And they will not learn what the debates are about from Parker and his colleagues.

"It's so utterly infuriating to find oneself quoted, consciously incorrectly, by creationists," Gould has said. "None of this controversy within evolutionary theory should give any comfort, not the slightest iota, to any creationist." Yet the scientific creationists, by misrepresenting the ongoing work of evolutionists, have helped the antievolutionary cause to gain more momentum than ever before in the twentieth century. Scientific creationists are widely viewed as learned scholars with impressive credentials, and more and more people are being persuaded that staggering evidence is on their side. Many scientists are baffled that such poor science can be so easily swallowed, and that creation is being taught as science in some schools around the country. Scientific creationism may be poor science, but it is powerful politics. And politically, it may succeed.

Laurie R. Godfrey teaches physical anthropology at the University of Massachusetts, Amherst.

Turn Your Bookshelf Into a Complete 21-Volume Science Library for Only $39.95.

"Men and Numbers" —Muir
"Celestial Bodies" —Copernicus
"Theory of Relativity" —Einstein
"Human Understanding" —Locke
"Communications in the Space Age" —Kappel
"Creative Evolution" —Bergson
"Origin of Species" —Darwin



"Irrational Numbers"—Dedekind
"Cybernetics" —Wiener
"Behind the Flying Saucers" —Scully
"Four Basic Elements" —Aristotle
"Computer and the Brain" —Neumann
"Division of Figures" —Euclid
"Burning-sphere" —Alhazen

BARNES & NOBLE BOOKSTORES

A Science Education from A to Z

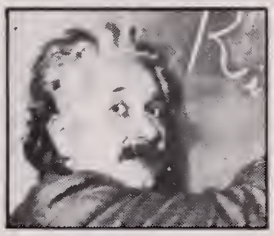
From the *ABC of Relativity* by Bertrand Russell, to Zeno's paradoxes, this 21-volume library provides a complete and fascinating science education.

Unlike an encyclopedia, this reference work is one you can read for pure enjoyment as well as refer to for reliable information. The key to this readability is the fact that THE REALM OF SCIENCE is actually a massive collection of selected writings arranged and indexed by subject. It is so complete, that the cumulative index alone runs almost 200 pages!

Think of a subject, look it up, and read what the world's foremost authorities have written about it.

The Greatest Minds the World Has to Offer

The authorities represented in this priceless collection read like a "Who's Who" in science. There's Priestley on the discovery of oxygen; Faraday on electrochemistry; E.O. Wilson on sociobiology; Ernst Nagel on Godel's proof. Plus Isaac Asimov, Jacob Bronowski, Martin Gardner, Max Planck, James Watson, George Gamow, Fritz Zwicky, and hundreds more. From ancient Babylonia to the present, you will be exposed to the greatest minds the world has to offer.



Einstein's special theory of relativity changed our concept of time, distance and mass.

A Valuable Research Tool

Although each volume contains its own index, the unique Science Concept Index "brings it all together." It will help you find vital information on a given subject, person, place or idea throughout the set. It will also enable you to trace various applications of a subject from one author to another, from one concept to another, or from one discipline to another. Imagine what a valuable research tool this can be. Taken as a whole, this 21-volume set provides an overview of science never before possible in a single work.

SOME OF THE CONCEPTS COVERED

- —Air
- —Astronomy
- —Atoms
- —Axioms·Lews·Principles
- —Behevior
- —Biology
- —Cells
- —Chemistry
- —Communication
- —Computers
- —Conservation
- —Continuity
- —Cosmology
- —Desert
- —Eerth
- —Ecology
- —Electricity end Megnetism
- —Elements
- —Embryology
- —Energy
- —Entropy
- —Equilibrium
- —Evolution
- —Force
- —Genetics end Heredity
- —Geology
- —Grevity
- —Heet
- —Heredity
- —Instruments and Apperetus
- —Infinity
- —Insight
- —Knowledge
- —Light and Optics
- —Logic
- —Men
- —Methematics
- —Metter
- —Measurement
- —Mechenics
- —Metebolism
- —Molecules
- —Motion end Momentum
- —Nebulee
- —Nuclear
- —Oceens, Seas end Weter
- —Peredoxes
- —Perity
- —Photosynthesis
- —Physics
- —Plenets
- —Pollution
- —Populetion
- —Redietion
- —Reletivity
- —Reproduction
- —Spece
- —Structure end Form
- —Systems
- —Technology
- —Tempereture
- —Time

SAVE $110

Pub. at	B&N Price
~~$149.95~~	$39.95

Act Now. . . Our Supply is Limited

THE REALM OF SCIENCE originally sold for $149.95. Until the supply lasts (We purchased the remaining inventory from the publisher), Barnes & Noble is offering the complete 21-volume set for only $39.95. That's about one-fourth of its original price. . . a discount of 73 percent!

Act now, and you won't be disappointed. (Each big *8" x 10"* hardcovered volume contains almost 200 pages and is fully illustrated.) If you are not completely satisfied with the set, return it within 30 days and the purchase price will be refunded.

73% Off! BARNES & NOBLE/ANNEX SALE

0361F

MAIL TO:
BARNES & NOBLE SALE ANNEX,
DEPT. RS 508
126 FIFTH AVE., N.Y., N.Y. 10011

Please send me_____set(s) of *The Realm of Science* at only $39.95 each, plus $3.00 postage and insurance charge (N.Y. residents: Please add sales tax). If I am not completely satisfied, I may return it within 30 days for a full and prompt refund or credit to my charge account.

☐ A check or money order is enclosed.
☐ Please charge this purchase to:

☐ VISA ☐ AMERICAN EXPRESS Card ☐ 4 digits above your name

Account # _____

Exp. date _____

Signature _____

Please print clearly

Name _____

Address _____

City _____

State _____ Zip _____

Order subject to acceptance by Barnes & Noble Bookstores, Inc.

For Faster Service

CREDIT CARD CUSTOMERS CALL TOLL FREE
1-800-228-2057/Ext. 15
Lines are open 24 HOURS
7 DAYS A WEEK
In Nebraska call 402-571-4900

1981 Barnes & Noble Bookstores Inc

Piltdown in Letters

The role of the famous priest in the infamous conspiracy is here disputed in epistolary fashion

by Stephen Jay Gould

In "This View of Life" for August 1980, a case was made for the active participation of the French priest and paleontologist Pierre Teilhard de Chardin in the fraud of Piltdown man. In the months following the publication of that column, Natural History *received many letters expressing a wide variety of views on this subject. Presented here are three letters in defense of Teilhard, along with a response from Stephen Jay Gould.* Natural History *welcomes additional letters on this scientific controversy.*

To the Editor:

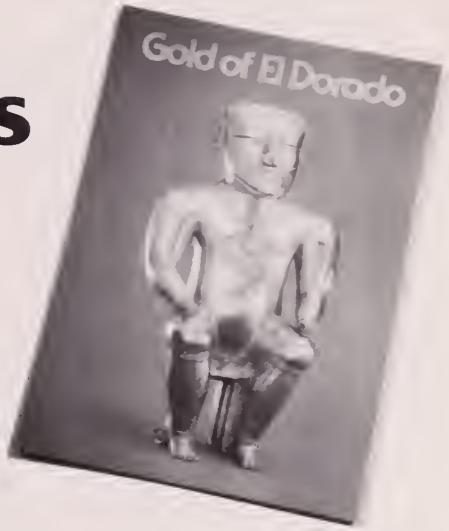
From the moment of discovery, the Piltdown "fossils" were the center of controversy. Piltdown apparently provided a human fossil on English soil, a maker for the eoliths, and proof that the brain came first in human evolution and that an anatomically modern braincase was present at the beginning of the Ice Age. Every conclusion was important and controversial, and for many years it was not possible to discuss human evolution without considering Piltdown. Hundreds of papers were written about the discoveries, but the problem remained. Anatomically it seemed impossible to associate the skull and jaw, but the chance association of an ape's jaw and a human skull in England seemed at least as improbable. The solution came when J.S. Weiner, Kenneth Oakley, and W.E. le Gros Clark showed that everything was fake—the bones had been stained, ape's teeth filed down, and fossils added to the assemblage to determine the antiquity. The whole matter is carefully reviewed in Weiner's *The Piltdown Forgery* (1955).

Obviously, from the point of view of science, the importance of discovering the forgery was to remove the chimera, as Franz Weidenreich called it, from the list of human fossils. In my opinion, the great interest in Piltdown lies in why major scientists accepted it, not in who forged it. Uncertain conditions of discovery, lack of geological information, and virtual anatomical impossibility did not deter many scientists from giving Piltdown a key position in their theories. As Alěs Hrdlička remarked on Piltdown in *The Skeletal Remains of Early Man* (1930), "It is another case where a desire to reach conclusions from insufficient and problematical material has led to a cloud of speculation and opinion." Yet many scientists did take a very strong position for or against Piltdown. To many it was the most important fossil in proving the antiquity of anatomically modern human beings, and any doubts about Piltdown were treated as an attack on a whole way of looking at human evolution. Piltdown was a center of very strong national, personal, and technical biases, and I think it is very difficult for people today (when there are so many well-preserved and -dated fossils) to realize how much emotion was invested in theories based on very little information.

Proof of the forgery finished scientific interest in Piltdown, but the very human question remained: Who had done it? This is very carefully considered in Weiner's book, and the story is much too long to repeat here. The core of the matter is that three people were personally involved in the excavations—Charles Dawson, Arthur Smith Woodward, and Teilhard de Chardin. Dawson took the originally "discovered" bones to Smith Woodward, a distinguished scientist at the British Museum. Later, Smith Woodward took part in the excavations, but it is not thought that he was involved in the forgery. His account of Piltdown is given in *The Earliest Englishman* (1948).

Dawson not only made most of the finds, but was present when the others—Smith Woodward and Teilhard—made discoveries. Prior to Piltdown, Dawson had been accused of plagiarism, fakes, and "undoubted deceptions." The evidence against Dawson is summarized in Wilton M. Krogman's "The Planned Planting of Piltdown: Who? Why?" (*Human Evolution: Biosocial Perspectives*, edited by S.L. Washburn and E.R. McCown, 1978), and I think that it is generally believed that he was involved in the forgery. After Dawson's death, Mrs. Dawson sent some parts of human skulls from her husband's collection to the British Museum, and it turned out that these had been stained with the same chemicals used in the forgery. I will return to the matter of

An Art Book That Took Centuries To Create



It took the American Museum of Natural History four years to arrange its exceptional exhibition of more than 500 pieces of ancient gold from Colombia. But those few years are a brief time when compared with the decades archeologists have spent digging (literally!) and studying the gold artifacts from tombs, caves, and buried sites. And all that time is short when compared with the many centuries prehistoric Indians practiced their craftsmanship and artistry to create these treasures.

So when it became the United States sponsor for this outstanding collection, the American Museum faced a dilemma. Could we do justice to all this effort and scholarship and beauty? We think we have. First, by dramatically displaying *Gold of El Dorado: The Heritage of Colombia* in one of our largest halls. The glowing reports from visitors tell us our efforts have been worthwhile. If you don't have a chance to see the show for yourself in New York, we hope you will see it in Chicago, San Francisco, or New Orleans on its year and a half tour.

The second challenge for the American Museum was the creation of an appropriate book to accompany the exhibition. We decided against a traditional catalog; against a small, boring volume with tiny black-and-white pictures that could never do justice to these fine objects. Instead, we decided to present a select number of the finest pieces of pre-Columbian gold in a large, stunning format. And to represent the three important elements that make a great art book we chose outstanding professionals.

First, photographer Lee Boltin. One of the greatest photographers of art objects, he also took the famous pictures of the Tutankhamun show. We sent him abroad to find and record great pieces of pre-Columbian art.

Second, archeologist Warwick Bray, from the University of London. One of the world's foremost authorities on pre-Columbian art, Bray is also a skilled writer, able to present fascinating background in a succinct, readable essay in the book. Dr. Bray organized the Colombian gold exhibition in London.

Third, Harry N. Abrams, Inc., America's leading publisher of fine art books. In a co-publishing venture with the American Museum, Abrams designed the book, supervised the preparation of 30 large color plates, and monitored the fine-quality printing.

The result is an unprecedented exhibition book. It is bold and big—each plate is 16 by 11½ inches—bigger than this magazine *opened up*. The paper is heavier than most posters. In fact, many persons have purchased two copies of the book in order to have one set of these fine art prints for framing.

And now for the happy ending. Because the Museum is a co-publisher, we are able to offer this soft-bound art book at a major savings from its normal retail price of $12.50. We are pleased to offer *Gold of El Dorado* to subscribers for only $6.25—a 50% savings off its regular price. This special offer is valid only during the exhibition and only while our limited supply lasts. We suggest that you order one or more copies immediately. Of course, if you are not satisfied after you have had an opportunity to examine it in your home, simply return the book and the Museum will refund the purchase price.

Natural History Books

Gold of El Dorado Book
American Museum of Natural History
77 West 77th Street
New York, N.Y. 10024

YES, I want to purchase _____ copy/copies of the Gold of El Dorado book. I ☐ enclose payment of/☐ authorize you to charge me $6.25 per copy (plus $1.00 for shipping and handling).

My name _____

My address _____

City _____ State _____ Zip _____

For charge orders only:

Charge to: ☐ Master Charge ☐ VISA ☐ American Express ☐ Diners Club

Interbank # (Master Charge Only) _____

Account # (All digits) _____

Expiration Date _____

Signature _____
(required if using credit card)

Order

_____ book(s) @ $6.25 $____

Shipping and handling $1.00

N.Y. Sales Tax (if applicable) ____

TOTAL $____

(Make checks payable to American Museum of Natural History)

the evidence against Dawson, but the question has been raised of whether he could have executed the whole forgery alone. Gould believes that there was a conspiracy, that Teilhard de Chardin was at the root of it, and that the evidence he presents is so powerful that "the burden of proof must now rest with those who hold Father Teilhard blameless."

When Piltdown was proven to be a forgery, I wrote to Teilhard asking him for a note for the *American Journal of Physical Anthropology* (I was editor at the time). He replied at once that he could not believe that any of the people with whom he had been associated was guilty and that he was sure some other explanation would be found. I think that this is what Teilhard really believed; he had taken no part in a forgery and could not believe that the friends with whom he had been associated had either. In a letter to Oakley (cited by Gould), Teilhard refers to the discovery as spoiling "one of my brightest and earliest paleontological memories."

I think that the view that Teilhard was fooled (along with hundreds of others, it might be added) is reasonable, and I will try to demonstrate that Gould's view is almost certainly wrong. However, it is important to remember that the Piltdown events took place before World War I, long, long ago. Dawson died in 1916, Smith Woodward in 1944. There are few facts, and little chance of obtaining more hard evidence after all these years.

Gould believes that the motivation for the original fraud was a joke. Gould writes, "I assume that Piltdown was merely a delicious joke for him—at first," and continues with his fantasy of Teilhard's motivations, his desire, his envy, his trickery. Not only are there no facts whatever to support these allegations, but they appear to reflect Gould's own mental processes far more than those of Teilhard. On his reconstruction of Teilhard's motivation, Gould writes, "Here I see no great problem. . . ." I see nothing but problems in reconstructing the events and motivations of seventy years ago. Gould has given us a picture that distorts the few facts there are, and I think that his whole view of Teilhard is false. The following reconstruction is, I believe, more reasonable than the theory of the joke.

Here are my thoughts on what happened. They are not offered as facts, only as a possibility, and only because indirect evidence is being used to attack the reputation of a person long dead who cannot set the record straight.

As Gould states, "Dawson, of course, unearthed most of the material himself." The various "discoveries" were made over a period of four years —bones were stained, teeth ground, associated fossils and tools provided. When the issue arose of what a canine tooth in such a creature would be like, a canine was "found." When added proof was needed to show that the jaw belonged with the skull, Piltdown 2 was "found."

My bias is that the whole pattern of preparation of the teeth, bones, collection of associated "fossils" and the repeated releasing of strategic specimens was the result of deliberate forgery and could not have been a joke. The only individual consistently involved with all of the discoveries over all the years was Dawson. If it is accepted that Dawson was the forger, then Teilhard was either fooled or he was a forger too.

Could the original discovery have been the joke, planted by Teilhard and found by Dawson? Even if we forget the elaborate nature of the preparation of the specimens, the staining of the first "find" and of the bones sent by Mrs. Dawson to the British Museum is the same. Further, the canine tooth may come from the original jaw. The events are not independent, so that some might have been jokes and other fakes.

If the joke theory is out because of the difficulties of secretly collecting the specimens, preparing them, and arranging for their discovery, what was the motive for the forgery? Dawson gained worldwide recognition for his finding of a fossil man. He reduced the chances of the truth being discovered (after giving the original "finds" to Smith Woodward) by having a distinguished scientist (Smith Woodward) and a friendly young priest (Teilhard) make additional discoveries.

In retrospect the motivations and methods seem clear. Teilhard enjoyed his friendship with Dawson and the excitement of the discoveries. It was an honor for him to be associated with Smith Woodward. He had nothing to gain by being a secret conspirator, and if he had been one, he risked everything—his reputation as a priest and as a scientist.

I think it reasonable to interpret the events in this way, but whatever the truth may have been, it should be noted that all the events took place before Dawson's death in 1916—no Piltdown fossils were ever found after that although searches were made.

Gould cites no direct evidence against Teilhard; his account simply puts all events in the worst possible light. He argues that the forger would not have dared to put the carefully prepared canine in the gravel pit for fear of it being lost rather than discovered. By implication one of the forgers found the canine. Nonsense. The tooth could have been put where it almost surely would have been found or easily retrieved for a second try.

On Piltdown 2, Gould makes much of the dates. Teilhard must have seen it in 1913, but the "find" was not announced until 1915. Dawson's reasons for not announcing it sooner involve Dawson's motivations, not Teilhard's. Teilhard was in the French army. To be shown a fake does not make a person a faker.

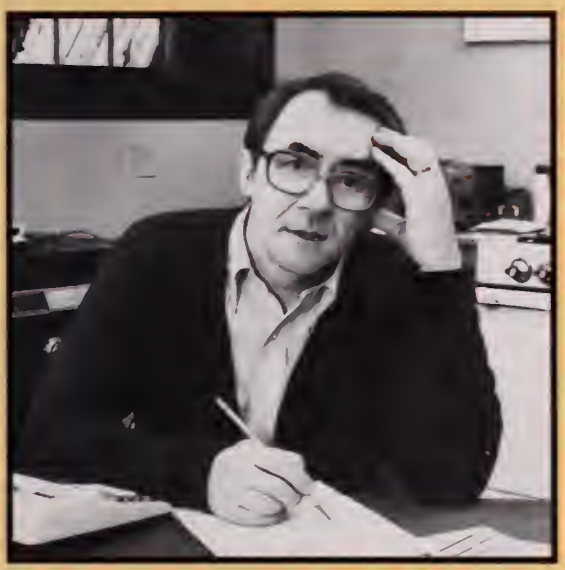
Teilhard thought that the jaw did not belong with the skull; many other scientists thought the same. The problem of the human joint and the missing condyle was pointed out immediately after the discoveries were described.

In 1915 G. Miller wrote, "*Deliberate malice* [emphasis mine] could hardly have been more successful than the hazards of deposition in so breaking the fossils as to give free scope to individual judgment in fitting the parts together." Note how close this is to the phrase "as if on purpose" that Gould finds so revealing. Miller cited nearly seventy references on Piltdown, and Teilhard offered no new suggestions on the relation of jaw and skull or condyle and jaw.

Gould makes much of the fact that he thinks Teilhard should have devoted more attention to Piltdown and that he did not because of his feeling of guilt. A different explanation is that Piltdown was a matter of intense controversy from the beginning. Perhaps his position with the church made Teilhard wary of becoming involved in futile, acrimonious controversy. His main interests were not at the level of debates on a single fossil but on a general philosophy of man. Teilhard had enjoyed making the discoveries and his friendship with Dawson and Smith Woodward, but he had no desire to enter into the Piltdown debate. This cannot be proved, of course, but I think Teilhard's actions are easy to

Some people feel...

"My house was robbed. My neighbor says I should 'pad' my insurance claim. Why should I have to lie to come out even?"



That's why we want you to know...

You don't have to lie to come out even. Your neighbor, like some homeowners, may be confused about what homeowners insurance actually provides for loss of contents. Some think it guarantees "replacement value." In fact, most homeowners insurance policies provide "cash value."

There is an important difference. "Replacement value" means the actual cost to replace—brand new—the stolen item. "Cash value" means the current *depreciated* amount the item was worth *at the time of* the loss.

For example, if your stereo is stolen, a standard homeowners policy would give you the "cash value." Assume you paid $1,000 for the stereo ten years ago; today it may be worth $500. So you would get $500 from your insurance company, minus the deductible you have selected.

Policies are available that offer "replacement value" or "agreed value." But, of course, these kinds of coverage are more expensive than the conventional homeowners policy. Which kind of coverage is right for you? Most people opt for the conventional homeowners policy. In the event of a major disaster, like a fire or a windstorm, it enables you to put your home together again. And in the event of a burglary, it will give you the fair "cash value" of the item you lost.

For more information, consult your insurance agent. Review your present coverage and ask about the kind of protection you feel you need. Determine costs. Check to see if your standard homeowners policy provides limited coverage on items such as paintings, prints, cameras, jewelry, silverware, or furs. If so, you may want additional coverage, or "floaters," for those valuables.

A frank talk with your agent can prevent surprises and create a better understanding of what you can reasonably expect from your insurance policy when you have a claim.

We're working to keep insurance affordable.

This message presented by the **American Insurance Association,** 85 John Street. NY. NY 10038

understand and certainly not proof of guilt.

Later, after the fake was exposed, Gould regards Teilhard's attempt to find explanation in the letters to Oakley as incomprehensible. But there is no problem if one thinks that Teilhard really believed his friends and associates of many years before were innocent. Why should he welcome the news that Dawson was a forger and that both he and Smith Woodward were dupes?

In instance after instance, an action or statement by Teilhard is taken to reflect guilt. For example, upon seeing the exhibit of the forgery at the British Museum, Teilhard is described as walking through "glumly." But an honest person seeing an exhibit that showed he had been hoaxed by a person he considered a friend might indeed feel glum.

Throughout the paper a misleading vocabulary is used—on page 14 Nixon is mentioned, and then on page 16 Teilhard is accused of "stonewalling." On page 14 Teilhard is described as hiding his real nature "behind a garb of piety." He did not "spontaneously" congratulate Oakley as "all other scientists" had. Reading this the unwary are likely to forget that the other scientists who took part in the excavations at Piltdown were dead.

There will, of course, always be uncertainty about the events and motivations of long ago. I happen to think that Teilhard was a sincere and honest human being, and that this accounts for the facts better than the idea that he was a forger. The joke theory just does not cover the facts at all.

In summary, one way of looking at the Piltdown forgery is that it started as a joke played by Teilhard de Chardin and that for the rest of his life he regretted it, but events had gone too far, and he did not have the courage to confess.

A different way of interpreting the same facts is that Piltdown was an elaborate and deliberate forgery, and that Teilhard was fooled, having trusted both Smith Woodward and Dawson. He expressed himself clearly on Piltdown, but avoided the bitter controversy as far as possible. He died a few months after the fake was discovered, still hoping that some other explanation might be found.

S.L. Washburn
Professor of Anthropology and University Professor Emeritus
University of California, Berkeley

To the Editor:

In reviewing the Piltdown forgery, Gould considers that J.S. Weiner has virtually proven that Charles Dawson was guilty of forgery, but he is looking for a coconspirator. He mentions the anatomist Sir Grafton Elliot Smith and the geologist W.J. Sollas, but he dismisses them as "farfetched and devoid of reasonable evidence." He then turns to Pierre Teilhard de Chardin, and after an extensive review of circumstantial evidence, he concludes that "Teilhard was an active coconspirator with Dawson at Piltdown." As to motive, Gould finds that "we must recast Piltdown . . . as a joke that went too far, not as a malicious attempt to defraud."

Other authors have speculated on possible coconspirators at Piltdown. Just before Gould, three French scientists (M. Blanc, G. Chapouthier, and A. Danchin) published a review of scientific frauds, including Piltdown. They mention Teilhard in passing but give more attention to Smith and Sollas, to both of whom they ascribe professional jealousy of Sir Arthur Smith Woodward, keeper of geology at the British Museum and principal advocate of Piltdown. They are inclined to consider Sollas as the most probable candidate, largely on the testimony of J.A. Douglas, Sollas's longtime colleague and his successor in the Chair of Geology at Oxford. In his retirement on the Isle of Wight, Douglas discussed Piltdown with R.L.E. Ford, his neighbor and an amateur paleontologist. Douglas preferred not to make his views public out of deference to the family of his predecessor, but Ford persuaded him to put them on record before his death. As he was then blind, he made a tape that was played at a symposium at Reading after his death in 1978. L.B. Halstead published parts of the transcript with a commentary in *Nature*. He noted that it was generally felt that the coconspirator must have been someone with considerable expertise and with animosity toward Smith Woodward. Sollas satisfied these requirements (as Teilhard did not). He was a leader of British anthropology, far above Smith Woodward (a specialist on fossil fishes) and the keeper of anthropology, W.P. Pycraft (an ornithologist). That Sollas detested Smith Woodward was well known to Douglas from personal experience, for he had attempted to mediate between them and had failed miserably. As professor of geology and paleontology at Oxford, Sollas had easy access to all of the bones used in the forgery. Further, he had bought a supply of potassium bichromate, a substance that was not in use in his laboratory at the time, but which was used to stain the Piltdown bones. Finally, Sollas and his photographer Bayzand had deliberately tricked Smith Woodward with another hoax, the Sherborne horse's head, then exposed him when he accepted it as genuine. Why not victimize Smith Woodward with a greater hoax, one for which Sollas was strongly motivated and for which he was eminently well prepared to provide both materials and expertise. On the basis of these facts and of long association with him, Douglas believed that Sollas had conceived the hoax and enlisted Dawson as a coconspirator.

Blanc et al. refer to an earlier paper by Pierre Thuillier that appeared in *La Recherche*. This is a review of two books that had just been published: *The Piltdown Fraud*, by Ronald Millar, and *Pleine lumière sur l'imposture de Piltdown*, by Guy van Esbroeck. As I have not seen these books, the comments below are based on Thuillier's review. Millar found circumstantial evidence that convinced him that Smith was the culprit and that his motive was jealousy and a desire to ridicule Smith Woodward and Pycraft. Smith, an Australian anatomist, was professor of anatomy at Manchester and later at London. He too had the needed expertise and access to bones for the forgery. He mocked Dawson by telling him that the Piltdown fossils had been confirmed by similar finds at Pilton, Australia. This was pure fabrication: neither the town of Pilton nor the fossils exist. Clearly, Smith exploited Piltdown to bait his English colleagues. This infers that he knew that Piltdown was no more valid than Pilton. And how better to get that knowledge than from participation in the conspiracy? One must wonder whether Gould could have dismissed Sollas and Smith so lightly had he not been, in his own words, "too blinded by my own attraction to the hypothesis of Teilhard's complicity."

Van Esbroeck introduced yet another potential conspirator, William R. Butterfield, curator of the Hastings Museum, of which Dawson was a committee member. According to van Esbroeck, Butterfield was anxious to

NOW WE KNOW WHAT IT'S LIKE TO BE ALONE.

It wasn't always this way.
It used to be hard to decide among all the 35mm SLR's.
Then we created the new Minolta XG-M. A camera so extraordinary it stands alone in its class. With an unrivaled combination of creative features.

First, it's automatic. So it's easy to get sharp, clear pictures. You just point, focus, and shoot. It even has electronic features that keep you from making mistakes.

As your skills advance, you'll appreciate advanced features like metered manual and exposure override for full creative control.

To further separate ourselves from the competition, we built in the option of professional motor-drive. Something normally found only on more expensive cameras.

It lets you shoot a blazing 3.5 frames per second. So you can catch a baseball as it comes off the bat. Or halt a horse leaping a hurdle.

But to fully grasp the XG-M's advanced design, you have to hold it.

The body feels rugged yet light. With a built-in textured grip that's sculpted to fit snugly in your hand. And oversized controls that make it easy to adjust to changing conditions.

As your creative potential develops, you'll have access to over 45 interchangeable, computer-designed Minolta lenses. As well as the Minolta system of SLR accessories.



All in all, the XG-M is a remarkable achievement. But then, we have over 50 years of remarkable achievements to draw on.

The new Minolta XG-M. Now we know how it feels to be alone.
But we're not complaining.

WAIT 'TIL YOU SEE HOW GOOD YOU CAN BE.

MINOLTA

For more information write Minolta Corporation
101 Williams Drive Ramsey N J 07446
Or see your Minolta dealer In Canada Minolta Ontario L4W 1A4

Product appearance and or specifications are subject to change without notice
©1981 Minolta Corporation

have certain specimens that Dawson had given to the British Museum. He swore vengeance on both Dawson and Smith Woodward. According to this version, Butterfield planted the bones in an area in which Dawson was collecting, and he thus duped Dawson as well as the "experts" of the British Museum.

Gould summarizes his case against Teilhard inversely as follows: "First, perhaps Piltdown has simply deluded another gullible victim, this time myself. Maybe I have just encountered an incredible string of coincidences. Could all of the slips in the letters have been innocent errors of an aging man; the *comme par exprès* merely a literary device; the failure to use his best argument a simple oversight; his conspicuous silence beyond a few fleeting and unavoidable mentions only an aspect of a complex personality that no one has fathomed; the elephant and the hippo Dawson's property . . . ?" If each clause of that long sentence were recast as a positive statement, taken together they would constitute a good summary of the case against Teilhard. Let us therefore use the sentence as the basis for a brief rebuttal.

"Could all of the slips in the letters have been innocent errors of an aging man?" Yes, easily and probably. I am ten years younger than Teilhard was when those letters were written. I am still sufficiently alert to keep a jump or two ahead of my students. Nonetheless, I sometimes find myself uncertain of the sequence of events much more recent than those of which Teilhard was writing. When an error is called to my attention, I sometimes have to reconsider and mentally recast the sequence of events several times before I am confident that I have it right. One of Teilhard's favorite words was *tâtonnement* ("groping"). It describes well the process seen in his letters, a mental process that is common to many of us. Gould's writing has a ring of great self-assurance, and perhaps the need for *tâtonnement* is not apparent to him, but I believe that it is an adequate explanation for the inconsistencies in Teilhard's letters to Kenneth Oakley. Thus, Oakley's original hypothesis was probably correct.

In his 1920 article, in which he clearly states that the Piltdown fossils are a mixture of bones of two different animals, Teilhard says, "As if on purpose [*comme par exprès*], the condyle is missing!" Gould believes that Teilhard was trying, a bit too subtly, to tell his colleagues that Piltdown was a fraud and that the condyle had been deliberately broken off the mandible to make a test of articulation impossible. Gould acknowledges that *comme par exprès* may be just a literary device. Similarly, physicists and engineers, faced with bad results, speak of the perversity of inanimate nature, while biologists refer bad results to the "Harvard law," that under the most precisely controlled conditions an experimental organism does just as it pleases. Teilhard's writing is characterized by literary figures to an unusual degree: why not this means of expressing his disappointment that the defects of the fossils prevent a critical test? But there is also a third possibility. After his youthful and amateur enthusiasm had been dampened by the critical thinking of Marcellin Boule's laboratory, and after his paleontological acumen had there been raised to a professional level, he may have suspected that Piltdown was a forgery, and he may have intended to suggest by *comme par exprès* that possibly the fossils had been deliberately altered to prevent a critical test. Suspicion does not require complicity.

Teilhard emphasized that evolution was ordinarily divergent, with long, separated lines often appearing as multiple, parallel lines. This is simply adaptive radiation. Gould says that Piltdown should have been Teilhard's strongest argument for multiple, parallel lines in human evolution, and so he believes that Teilhard's failure to use it must have been caused by his guilt in the Piltdown conspiracy. But was Piltdown Teilhard's best argument, "the only available proof," as Gould says, "of multiple, parallel lineages within human evolution itself." Neanderthal man had been known since 1856, Cro-Magnon since 1868, and Galley Hill since 1888; *Homo erectus* had been known from Java since 1891 and was discovered in China in 1927 (by a team that included Teilhard), long before Teilhard wrote his most important works; and Heidelberg had been known since 1907. Other "parallels" discovered after Piltdown, but before Teilhard wrote the works upon which his fame rests, include Ehringsdorf (1925), Steinheim (1933), and Swanscombe (1935). One might also mention *Australopithecus* (1925), which has at times been assigned to the genus *Homo*. In the face of this array of fossils in the human lineage, could Gould cite Piltdown as "the only available proof" for Teilhard's thesis unless he were, in his own words, "too blinded by my own attraction to the hypothesis of Teilhard's complicity."

If we agree that Teilhard had abundant fossil evidence for his theory, one must still ask why he did not use Piltdown also. The answer is evident in his paper of 1920: he dissociated himself from the usual interpretation of the Piltdown fossils, and he may have suspected forgery. At best, therefore, its use was likely to lead to confusion; at worst, to totally erroneous conclusions. Having once stated his opinion on it fully, why not move on to more profitable materials? Much the same reasoning applies to "his conspicuous silence."

I believe that Gould's best argument is Teilhard's "profound embarrassment" when Oakley showed him the exhibit on the Piltdown fraud at the British Museum, and on other occasions when Piltdown was discussed. Nonetheless, it is understandable on grounds other than complicity. Teilhard's acquaintance with Dawson and Smith Woodward came in the days when he was an enthusiastic amateur with little hope of achieving professional status in paleontology. It may have been partly their influence that directed him toward a career in paleontology. He was characteristically intensely loyal to his friends and very slow to believe evil report about anyone. Thus the idea that his much admired friend Dawson, and perhaps others of the early Piltdown investigators, had deliberately defrauded the scientific community was distasteful in the extreme. He reacted with an embarrassed avoidance of the repugnant subject.

Because of Teilhard's experience at Cairo and his connections with the network of amateur collectors, Gould believes that he was likely to have obtained the elephant and hippo bones that were planted at Piltdown. Perhaps, but it should be added that Sollas, Smith, and Butterfield also had excellent access to networks of collectors, both professional and amateur.

Before summarizing, let me discuss a few minor points in Gould's article. At the outset, he refers to Teilhard as "one of the world's most famous theologians." On the contrary, he was not a theologian at all. Of course, he had studied theology as a seminarian.

The greatest exhibition of Shakespeare ever to travel is now at the American Museum of Natural History.



Enjoy the elegance of Elizabethan England in a unique display of memorabilia.



Experience the color and pageantry of court, country and city life.



See original 19th-century costume sketches from the Bard's most magical comedy.



Recapture performances of the world's finest actors in Shakespearean roles.



View the portrait of Shakespeare on the title page of the 1623 First Folio.



Relive the moments of history that Shakespeare chose to immortalize.



Imagine yourself at the theatre in this famous model of the London Globe.



Engrave this 1618 etching of Henry V in your memory.



Get thee to the exhibition!

June 18 through September 20

(The American Museum of Natural History–Central Park West at 79th St.)

Shakespeare: The Globe & The World is an exhibition from the collection of the Folger Shakespeare Library, Washington, D.C. Made possible by grants from the National Endowment for the Humanities, Metropolitan Life Insurance Company, Exxon Corporation and the Corporation for Public Broadcasting.

Metropolitan

EXXON



THICK 'N THIRSTY TOWELING HAT



Thirsty terry cloth toweling is shaped into a hat that beats summer heat. Use it to wipe your perspiring brow or douse it in water, wring it out and wear it to keep you cool at tennis, golf, boating, fishing, camping. **Sizes:** S(6¾-6⅞), M(7-7⅛), L(7¼-7⅜), XL(7½-7⅝), XXL(7¾-7⅞). **Colors:** Sailing Blue, Powder Blue, White, Yellow. **Toweling Hat $7.75** ppd.

Order Today! Money Back Guarantee!

Enclosed is my check or money order for $ _____
(Add sales tax where applicable.)

Please RUSH my # 2002 Toweling Hat.

Size _____ Color _____

Name _____

Address _____

City _____

State _____ Zip _____

☐ Send me your FREE color catalog of quality outdoor apparel and equipment.

Eddie Bauer®

Dept. GNH, Fifth & Union, Seattle, WA 98124



Send $3 for catalogue to NH-06
Box 31442, San Francisco CA 94131
Boutiques in San Francisco, Palo Alto & Cupertino, CA

Similarly, all biologists study some chemistry, physics, and mathematics, but that does not make us chemists, physicists, or mathematicians. It is a common mistake to equate "priest" and "theologian." Later, Gould says that Teilhard "seemed to hide passion, mystery, and good humor behind a garb of piety." This seems to suggest hypocrisy, and I believe that it is not only unjustified but that it contradicts those who worked with him most closely (for example, George B. Barbour and Helmut de Terra).

Teilhard wrote to Oakley that, as a theology student at Hastings, he had not had much free time. Gould finds this inconsistent with Teilhard's letters to his parents, in which he talked much about travels in southern England. Again, it appears that the conflict is in the interpretation rather than in the facts. Anyone who knows anything about the Jesuit seminary curriculum knows that it is an onerous one that leaves minimal spare time. Nonetheless, there is always some time for recreation. When students write home, they rarely send transcripts of class notes. They are more likely to write about recreation, hobbies, and special interests, even if these occupy only a small part of their time.

Gould says that "Leakey also mentioned Teilhard's knowledge of chemistry and the clever staining of the Piltdown bones." Was his knowledge of chemistry out of the ordinary? He did no graduate work in chemistry. The main evidence of his expertise in this field is that he taught elementary chemistry for three years at the Jesuit college in Cairo. To teach elementary chemistry in a classical college, however, does not require any unusual mastery of the subject. Most of the principals in the case, as science graduates of British universities, probably equalled or surpassed Teilhard in this respect.

Let me summarize the case as I see it. Teilhard went to England as a seminarian with a strong extracurricular interest in natural history, especially geology and paleontology, and he put as much time into his hobby as the curriculum would permit. He soon met other amateur collectors, including Dawson, a lawyer who had been collecting in Sussex for many years and who had sent enough materials to the British Museum to make up a "Dawson collection." Teilhard was much impressed by his new friend and probably flattered that so senior and distinguished a collector should take an interest in him. When Dawson confided that he had found probable fossils of very early man, and especially when so distinguished a scientist as Smith Woodward championed the fossils, it could not fail to make a tremendous impression on a young amateur who had only dreamed of finding important fossils of early man and of receiving the confidence of scientists of the importance of Smith Woodward. In such a situation, it is hardly surprising that he was overawed, tended to romanticize the incident, and accepted it as presented by Dawson and Smith Woodward.

Upon returning to Paris, he began his work under Boule. Here, for the first time, he studied mammalian, primate, and human fossils systematically, and he learned the critical attitude toward them that was so characteristic of Boule. Here he became convinced of the incompatibility of the Piltdown jaw and cranium. At best, these now appeared as an accidental association of unrelated parts; at worst—could it have been fraud? Possibly he was suggesting this very tentatively with the phrase *comme par exprès*. He shrank from the repugnant possibility that any of his friends might have been involved in such an act. In any event, having once called it right (1920), he then put it out of mind and went on to other materials that did not raise such distressing problems.

When, forty years after the events, Oakley questioned Teilhard, it is hardly surprising that he had to grope for the answers. Far from suggesting complicity (as it might, had it concerned recent events), it merely suggests that, for all the sublimity of his thought, he was still very much a man with human limitations, even as the rest of us.

After all of this, I must concede that it is possible that Gould is right, although I do not consider it probable. If so, his hypothesis of a joke that got out of hand seems to be the best available explanation. The French love to twist the tail of the British lion, and Teilhard was a quintessential Frenchman.

But if not Teilhard, then who? Smith and Sollas are implicated far more strongly than Gould concedes. On the basis of Douglas's statement, I would consider Sollas to be the most probable coconspirator. As I have not seen van Esbroeck's book I cannot assess

the probability of Butterfield's complicity, but neither can I dismiss it out of hand. Finally Weiner mentions several other people who, in various ways, were associated with the Piltdown finds. Among these, I select for mention Sam Woodhead, a chemist friend of Dawson's, and Lewis Abbott, a competing collector who had a strong dislike for Dawson. Thus, a considerable number of potential coconspirators are in the field. And we must not overlook the possibility that there may have been three or more conspirators at Piltdown.

The late W.R. Brooks, founding chairman of the Department of Biology at John Hopkins, said that "suspended judgment is the greatest triumph of intellectual discipline." Until definitive evidence is available, we should aspire to that triumph in regard to the Piltdown conspiracy.

Edward O. Dodson
Department of Biology
University of Ottawa

To the Editor:

Many years ago I referred in a lecture to the Piltdown forgery. Subsequently I was admonished by two angry British dentists. "An Englishman would never do such a thing, but don't forget, one tooth had been found by a French Jesuit."

In this magazine for August 1980, there appeared an article by Stephen Jay Gould trying to prove that Father Teilhard de Chardin had knowingly been involved in the Piltdown fraud. Gould is as positive in his interpretations and conclusions as he is wrong, and his article cannot be accepted without protest and correction.

It is not necessary here to repeat the story of "Piltdown man," which turned out to be a chimera, a composition of a hominid braincase and the mandible of an ape. Irritating from the beginning, this find had troubled a whole generation of earnest scientists. Teilhard, then a young and inexperienced man, had contact with Charles Dawson, the alledged discoverer, and participated on occasion in his fieldwork. This makes Teilhard part of the Piltdown story. The other person involved was Sir Arthur Smith Woodward of the British Museum, a scholar of considerable reputation.

Dawson had long been suspected to be the perpetrator of Piltdown man. But there was no proof of this. In a painstaking, thoroughly convincing way, Kenneth Oakley and J.S. Weiner

Old World Charm



Québec City Québec
Cobbled streets. Café au lait at quaint little restaurants. Houses with gingerbread roofs and balconies. Chanteuses who'll sing to you from the heart. Come on up.

Canada
SO MUCH TO GO FOR
Tourisme Québec. C.P. 20 000, Québec G1K 7X2

BECOME AN INSTANT MUSICIAN. NO EXPERIENCE NECESSARY.

The new Casio VL-Tone gives you command of 5 instruments, 10 rhythm sections—and literally millions of easy-to-create sound variations.

So even amateurs can play overtures.

The secret is LSI technology, adapted to the re-creation of sounds and rhythms in electronic form. It lets you play compositions that normally take years of musical training—in no time. And play them back, at the push of a button. Or pick up the tempo. Slow it down. Store it in memory. Start with a Samba—and flick to any other rhythm instantly. There's always something new.

Uses 4 AA batteries. Can take earphones. Also plugs into your home stereo for larger sound. Volume controls. Full function memory calculator. Year warranty, case, full instructions. 1" x 11¾" x 3". 30-day guaranteed return privilege included. AC adapter and special songbook are optional.

Call now. Own the most extraordinary musical instrument in the world.

5 musical instruments squeezed into 11 inches.



30-DAY HOME TRIAL

Credit card holders may use our toll-free numbers below. Or send check, including delivery charge (shown in parentheses). Add 6% sales tax in CA. Please specify product number and magazine.
Casio VL-Tone #395 $69.95 (3.50)
AC Adapter #397 $7.25 (.75)
VL-Tone Songbook #403 $5.00 (.75)

800 227-3436
In California 800 622-0733

THE SHARPER IMAGE™
260 California St., San Francisco, CA 94111
(415) 788-8880 ©1981 The Sharper Image

"WOLVES"
by
James E. Faulkner
Two of Mr. Faulkner's magnificent oil paintings have been reproduced as beautiful limited edition prints. Both editions are printed on 100% rag paper and limited to **only 950 prints.** Each print has been **signed and numbered by the artist** and will be mailed flat, 1st class mail. Your complete satisfaction is guaranteed.

The first 200 of each print will be sold together as sets with matching numbers.





"MOONLIGHT LAMENT"
14¾"x18¾"
(above) unmounted
$42.00

"WOLF PUPS"
16"x21" (left)
unmounted $48.00

Both prints with matching numbers, unmounted $85.00

Send check or money order to:
NATURE'S NEST

1426 Pearl Street
Boulder, Co. 80302
(303) 443-2245

showed that the skeletal remains were modern and not of Lower Pleistocene age as alleged; that the bones and implements had been artificially stained to suggest fossilization; that the teeth of the mandible had been filed; and that the mammalian fossils had come from elsewhere. Every bit of "evidence" pointed to Dawson. Yet, at the end of his book Weiner hesitated to come to a definite conclusion. None of the facts presented in his book "furnishes the positive and final proof of [Dawson's] responsibility." Was this just fairness against a deceased man, or was Weiner afraid to get into trouble with the Dawson family? After all, Dawson's son was a prominent government official. More important was Sir Arthur, the grand old man who had followed the Piltdown story from the beginning and had known everybody involved. Shortly before he died, Sir Arthur stated that information furnished him by Weiner "left me no doubt that the man I had the greatest reverence for [Dawson] *had deliberately misled his best friend,* who stood rather outside the Piltdown discovery" (*Sunday Times*, January 9, 1955).

Dawson was a solicitor and a roving amateur in many ways. But did he have the intelligence to plan the complicated forgery himself? From where did he get the material? What motivated him?

It has long been suspected that there must have been a trained scientific man behind Dawson. The Piltdown mystery must have been a conspiracy. Yet who was the second man, the perpetrator, the shadow figure in the background? Two were named in this connection: Grafton Elliot Smith and Teilhard de Chardin. Ronald Millar, not convincingly, tried to put the blame on Smith. Now Gould bluntly accuses Teilhard de Chardin.

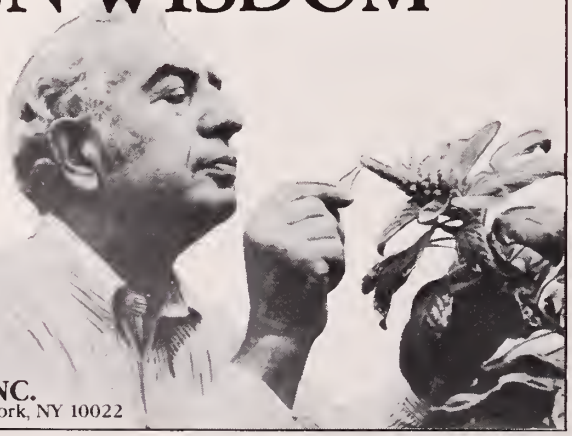
In this article Gould uses every bit of information, every uncertainty in the record, every dubious attitude of Teilhard's as evidence of his complicity. In 1953, Teilhard's recollection of what had happened before the First World War was really so uncertain that he thought of having met Dawson for the first time in 1911 while actually it had been in 1909. Had this (according to Gould) been written on purpose, or had Teilhard just "misunderstood the exact chronology"? When later on, "Teilhard's silence about Piltdown becomes inexplicable to the point of perversity (unless guilt and knowledge of fraud engendered

Unlocking the secrets of plants

One of America's leading botanists, the author of a popular column in *Natural History* magazine, provides a revealing look at "green wisdom"—the remarkable behavioral strategies built into plants. Through a series of vividly written vignettes, the author gives "a lucid account of how plants of all sizes manage to overcome challenges and prosper. But GREEN WISDOM does more than provide entertaining information. It gives the reader a chance to see in each example of plant life a pattern that can be applied by imagination to the improvement and enrichment of human life."—Rene Dubos

GREEN WISDOM

ARTHUR W. GALSTON



Illustrated, $12.95 at bookstores, or direct from the publisher.
Bulk discount available to garden groups and shops, upon request.

BASIC BOOKS, INC.
10 East 53rd Street, New York, NY 10022

it)," then the perversity is Gould's. Might he not have thought of another explanation more in accord with Teilhard's great reputation as an honest scientist? That, conceivably, insight and experience were behind Teilhard's attitude?

In 1929 Teilhard went to Peking just in time to become involved in the discovery of Peking man. He could study the remains prior to publication and discuss the question of human evolution and Piltdown man with Davidson Black and later with his successor, Franz Weidenreich. The latter gave an outspoken verdict about Piltdown. He, in 1932, proved the mandible to be that of an orang; Friederichs, one of his pupils, even suggested a special genus of anthropoids for that find—*Boreopithecus*. Already earlier G. Miller, in 1915, had thought the jaw belonged to a chimpanzee, and so did others, such as Remström (1916), Gregory (1916), and Lonshossek (1920).

That the Piltdown mandible belongs to an ape, and the canine he found as well, must have been a personal blow for Teilhard because he had found the canine, in August 1913, "in the rain-washed gravel spread" on the surface, while at the same time Dawson and Smith Woodward were excavating nearby. Therefore, Dawson was around, and knowing the history of the finds (Weiner) there could be no doubt that Dawson must have "planted" the tooth on purpose, ultimately to be discovered by Teilhard. It was this find by which Teilhard was inadvertently dragged into the Piltdown fraud.

Teilhard had ample knowledge of the Pleistocene fauna and naturally must have known that a Pleistocene ape could for climatological and ecological reasons not have existed in Europe. Therefore, he must have felt deceived and cheated. He loathed, no doubt, to suspect anybody and did not want to have anything to do with the case. After the forgery had been disclosed and a special exhibition had been presented by the British Museum, Teilhard did not even want to look at it. He had had enough of Piltdown. This, in contrast to Gould, is my explanation of Teilhard's changed attitude in the Piltdown case.

About the alleged stone implement, Gould writes, "I also have some doubt about Teilhard's flint, for it is the only Piltdown item indubitably found *in situ*. Now, if we look into Weiner's

Rise Above It All



Vancouver British Columbia

Shiny, new cities that have kept a place for the past. Where you can take four o'clock tea. Or take in the town on a double-decker bus. Shop for woollens, china or an Indian carving. Come on up.

Canada
SO MUCH TO GO FOR

Tourism British Columbia, 1117 Wharf St. Victoria, B.C. V8W 2Z2

What your home could have in common with the Met, the Tate, and the Louvre.



Anton Cetin's *Ere*

Beautiful, original works by artists who are represented in the world's great museums and galleries can be yours for very reasonable prices.

We offer original etchings, lithographs and serigraphs signed by Calder, Chagall, Dali, Miro, Vasarely and other important artists.

Anton Cetin's primitive etching, *Ere*, is one of the many fine prints we've made available.

Our expert advice and full money-back guarantee are your assurances that the art you buy will have lasting value and beauty.

Send for our colorful, descriptive catalogue, without obligation.

Original print collectors group, Ltd.
215 LEXINGTON AVE., DEPT. NH-30, NEW YORK 10016

PLEASE SEND ME YOUR FREE COLOR CATALOGUE AND LATEST NEWSLETTER.

NAME _____
(PLEASE PRINT)

ADDRESS _____

CITY _____ ST _____ ZIP _____

© 1981 OPCG, LTD

FINE ANTIQUE BIRD PRINTS





VPC 0109 MILVUS MIGRANS SPIZAETUS ALBONIGER VPC 0110

This fine pair of feathered hunters, after John Gould portfolio originals, were faultlessly executed by Joseph Wolf, "the Bird Man," renowned artist/naturalist of the 19th Century. Our full colour Imperial Folio reprints, in limited edition, on heavy archival art paper, are a visually appealing addition to the decor/collection of those who appreciate the finest of Nineteenth Century bird prints. To order this fine pair of prints, send $90.00 (check or M.O.) or telephone and use your Master Card/VISA. Our Catalog containing these and other fine prints is available for $2.00.

(Dealer inquiries invited.)

• Vintage Image®

Dept. C61, P.O. Box 480476, Los Angeles, CA 90048 (213) 389-2650



SEMINARS IN ORNITHOLOGY

The Laboratory of Ornithology at Cornell University Offers a Home Study Course in Bird Biology

Inquire: NH, 159 Sapsucker Woods Road, Ithaca, NY 14850

book, we find, "The paleolith flint (nr. E. 606), however, provided a notable exception . . . this was found in situ by Teilhard de Chardin. . . . But that this fragment has been deliberately stained admits of no doubt." The person who had stained the bones also had stained the flint. For details one might look up Weiner's book, which actually reads like a detective story. The implement must have been placed at the site with the purpose of deceiving Teilhard and this could, in view of the former suppositions, only have been done by Dawson.

Gould's suggestion that Teilhard was presumably an ardent French patriot is noteworthy: "what a wonderful joke for a Frenchman . . . what an irresistible idea to salt English soil with this preposterous combination of a human skull and an ape's jaw and see what the pros could make of it." What an incredible insinuation against an honest scholar!

Gould's article is based entirely on speculations. Could it really satisfy anybody to maintain that "Teilhard was an active collaborator" of Dawson's alleged conspiracy? "Only in this way," according to Gould, "can I make sense of the pattern in Teilhard's letters to Oakley, the 1920 article, the subsequent silence, the intense embarrassment."

Who then was the mastermind behind Dawson, and what was the motive? The oldest prehistoric man an Englishman? National pride or perhaps the reward of becoming a fellow of the Royal Society?

At long last, by an event as surprising as it was unexpected, we are able to present a reasonable explanation. The person responsible for the fraud was Professor W. J. Sollas of Oxford. The late Professor J. A. Douglas (1884–1978), who held the Chair of Geology at Oxford and was a close friend of Sollas, had known the truth. Shortly before his death, Douglas transmitted the story by tape recording. He had a "bitter dislike of Smith Woodward, which was mutual." He wanted to make a fool of him, to ruin his scientific reputation. And this led to the Piltdown forgery. (As reported by B. Halstead in *Nature,* vol. 276, pages 11–13.) It is a pity that this revelation should have been overlooked by Gould. Otherwise his concoctions would never have been printed.

As for Teilhard's alleged "guilt," it is quite evident that he was but an interested yet innocent bystander

of the Piltdown case, who had the misfortune to pick up the canine tooth and the flint, *in situ* at the site where the shameful forgery was committed.

G. H. R. von Koenigswald
Department of Paleoanthropology
Senckenberg Museum
Frankfort/Main B.D.

Stephen Jay Gould replies:

I began my first article on Piltdown (*Natural History*, March 1979) with the words: "Nothing is quite so fascinating as a well-aged mystery." Thus, I cannot feign a scholar's surprise and claim astonishment at either the volume or the vehemence of correspondence provoked by my case for Teilhard de Chardin as a coconspirator in the most celebrated of anthropological forgeries (*Natural History*, August 1980).

I was pleased by the favorable reaction of most correspondents, especially by the recognition of so many that my case was not born of malice toward Teilhard. For if I have emphasized any theme over eight years of these columns, it is the human side of science and its embeddedness in social contexts. If I am right, I do not see how Teilhard's greatness is diminished by a youthful caper that caused him continual pain thereafter. A tragedy provoked without malicious intent by one's own hand is perhaps the most poignant burden that anyone can bear. As a Jesuit priest wrote to me: "I do not know if you are right, but the spirit of your argument commands respect. After all, our church maintains the institution of confession because we know that people err—even priests."

Favorable respondents write short notes or pass a friendly oral remark. Long commentaries—quite appropriately—are the domain of critics. I merely wanted to say that the three published here are not the tip of an iceberg of discontent, or, if they are, the iceberg of good cheer is at least as large if not so heavy.

In these three commentaries, Teilhard's friends and supporters react. Professor Dodson spent a sabbatical year at the Fondation Teilhard de Chardin in Paris. Professors Washburn and von Koenigswald, two of the most eminent physical anthropologists of our century, were friends and colleagues of Teilhard. Their covering letters express an anger not found—and I thank them for it—in their actual responses. I am neither sorry nor

Call Of The Wild



Georgian Bay Ontario
More trees and streams and lakes than the mind can comprehend. Some singularly beautiful. Others lost in the panorama of the view. Something for the senses. Come on up.

Canada
SO MUCH TO GO FOR
For information call collect. 416-965-4008

THE MARK OF A BOOK LOVER





Identify your books with a personalized hand embosser just like those used in libraries. The 1½" diameter seal embosses a page with "Library of (name)" and three initials.
To order Item #9304A, be sure to specify BOTH full name and up to three initials desired. Send 22.40 postpaid (plus 5% sales tax if delivered in Texas) in check or money order (sorry, no COD's) or charge to MasterCard, VISA or American Express (include card name, all digits, expiration date and signature). Allow six weeks for delivery. Mail to:
The Horchow Collection, P.O.Box 34257, Dept. 41710, Dallas, TX 75234

HORCHOW



PARADISE FOUND.

The jungle resort of Canaima, only reached by plane from Ciudad Guayana–our stop 180 miles up the Orinoco River in the heart of Venezuela. Here, on a bluff above a dark lagoon–its surface churned by seven tumbling waterfalls–you'll look out on dense jungle, and truly feel like a stranger in paradise. And this is only one call made by the intimate Stella Oceanis, as she follows a yacht itinerary in a series of 14-day Leeward to the Orinoco Cruises out of San Juan this winter. For details, see your travel agent. For more information, send this ad for our brochure or call us collect at (212) 397-6400.

Sun Line, One Rockefeller Plaza, NY, NY 10020. Room 315. Greek registry.



Name_____

Address_____ NH1

City_____ State_____ Zip_____

My travel agent is_____

STELLA OCEANIS

surprised by these commentaries, although I am disappointed in one sense (and secretly pleased in another) by their weakness based upon a common failure to state accurately or even to consider the major points of my case. (My pleasure, of course, derives from the survival, if not strengthening, of my hypothesis in the face of criticism from its potentially most severe and knowledgeable critics.)

A standard method of attack against complex hypotheses involves chipping away at unimportant and admittedly weak points, ignoring the strong points, and then hoping that the edifice might tumble by implication. Because I anticipated such a response, I was careful to list my arguments explicitly in the order of their strength as I saw it. I even numbered them and stated that the first two were my essential claims, and all the others subsidiary. Yet both Washburn and Dodson devote most of their responses to the subsidiary points.

The first two-thirds of Washburn's commentary is primarily an argument for Dawson's involvement in pursuit of fame. I disagree with none of this and find most of it irrelevant to my case. Washburn seems to be under the misconception that I tried either to exonerate Dawson or to paint Teilhard as the mastermind and Dawson as the tagalong. On the contrary, I clearly stated my assumption of Dawson's guilt on the first page: "J. S. Weiner's elegant case virtually precludes Dawson's innocence." On the same page I wrote that Dawson had "found" the initial bones before Teilhard arrived at Piltdown and that he must therefore have been the chief perpetrator of the hoax. The only possible relevance of the first two-thirds of Washburn's letter relates weakly to my speculations about Teilhard's motive (a theme that I regarded as the least important of my piece and therefore relegated to the last page —we can only speculate about motives, but we can present facts about involvement). Washburn argues that if Dawson was a forger and if Dawson acted maliciously for fame, then Teilhard was either innocent or also acted from malice (and not for a joke, as I speculated). But how does this follow? If we know anything about conspiracies in all their murkiness, we certainly understand that people get involved in common projects for the damnedest and most varied motives. Do any of the Kennedy assassination

buffs believe that Oswald, Ruby, and the masterminds undertook their deeds for common reasons?

When Washburn does reach my specific arguments, he begins with my very last point, Teilhard's "good luck" in finding the canine tooth, of which I stated: "It is the weakest point of all, hence its place at the bottom of my list."

Dodson proceeds in much the same way. For example, he attempts to demolish what he takes to be one of my strong points in almost the very words I used in labeling it a weak point. To the argument that Teilhard might have supplied African elephant and Maltese hippo teeth to the "associated fauna" at Piltdown, Dodson writes: "Perhaps, but it should be added that Sollas, Smith, and Butterfield also had excellent access to networks of collectors, both professional and amateur." I wrote, labeling the point as my next to weakest: "I regard this argument as suggestive, but not compelling. Dawson too was plugged into a network of amateur exchange." Dodson then spends a paragraph attacking Leakey's point that Teilhard taught high school chemistry in Egypt and may therefore have known how to stain the bones. But I regarded this argument as so by-the-by that I didn't include it in my list at all.

When the three commentators do consider my two major points, they either state them incorrectly, or so incompletely that my arguments are unfairly represented and converted to straw men. Let me then rehearse the two foundations of my case and comment upon the attempted rebuttals:

1. Teilhard wrote a series of letters to Kenneth Oakley in 1953. In the first, he slipped (fatally, I believe) in stating that Dawson had shown him the site of the second Piltdown find and explained to him that he "had found the isolated molar and the small piece of skull in the heaps of rubble and pebbles raked at the surface of the field." This is impossible because Dawson "found" the bones in 1915 and Teilhard was sent to the front in December, 1914. If Teilhard saw the Piltdown 2 material, he probably helped Dawson to manufacture it before he left. Oakley caught the inconsistency immediately and pressed Teilhard. Teilhard's subsequent letters contain what I take to be a studied retreat surrounded with a set of other misstatements or half statements, all forming a pattern, carefully constructed, in my opinion, to suggest innocence and avert suspicion. In my article, I placed primary emphasis upon the *pattern* of misstatement. I acknowledged that each individual point could be given an exonerating interpretation, but that my case resided in the common pattern of all misstatements—"each insignificant (or subject to other interpretations) by itself, but forming in their ensemble a subtle attempt to direct suspicion away from himself."

Washburn devotes but one short paragraph to this essence of my case, says nothing about my claim for pattern, and dismisses my central point about the Piltdown 2 specimens by stating: "To be shown a fake does not make a person a faker." I agree, but I explicitly discussed this possibility and gave my argument against it. I framed Washburn's claim as follows: "Dawson showed the specimens to an innocent Teilhard in 1913, but withheld them from Smith Woodward

The Soligor 80-200mm Expand Your Horizons By Getting Close.



You've got a terrific 35mm SLR camera, but not all of your shots are terrific. Some suffer from too much unwanted scenery, some from tiny people in big frames...shots that didn't work because your creative I.Q. was more than your *lens* could handle.

That's right, lens. But, Soligor has a solution: the affordable, innovative Soligor 80-200mm One-Touch Zoom + Macro lens that lets you and your camera turn blah into beauty.

Zoom in to crop out extraneous details. Bring your subjects up to 4 times closer than a standard lens can. Frame your shots exactly as you want them, and Soligor quality captures them faithfully. Create exciting portraits, instead of just pictures of people; capture a still life or sports action as the kind of picture you bought your camera to get; experiment with amazing close-ups, thanks to macro ability. And it's all so easy with Soligor's single One-Touch control for zoom, focus and macro.

If some of the zip has gone out of your picture taking, zip down to your Soligor dealer and try our 80-200mm on your Canon, Minolta, Pentax, Olympus, Nikon or other fine camera. Or, write for full information.

SOLIGOR®
MAKES THE DIFFERENCE

AIC Photo, Inc. Carle Place, N.Y. 11514
In Canada Kingsway Film Equipment, Ltd Ontario

until 1915." I then responded to this potential interpretation:

> Dawson would not blow his cover in such a crude way. For Dawson took Smith Woodward to the second site on several prospecting trips in 1914, always finding nothing. Now Teilhard and Smith Woodward were also fairly close. Dawson had introduced them in 1909 by sending to London some important mammal specimens (having nothing to do with Piltdown) that Teilhard had collected. Smith Woodward was delighted with Teilhard's work and praised him lavishly in a publication. He accepted Teilhard as the only other member of their initial collecting trips at Piltdown. Moreover, Teilhard was a house guest of the Smith Woodwards when he visited London in September 1913, following his discovery of the canine. If Dawson had shown Teilhard the Piltdown 2 finds in 1913, then led Smith Woodward extensively astray during several field trips in 1914, and if an innocent Teilhard had told Smith Woodward about the specimens (and I can't imagine why he would have held back), then Dawson would have been exposed.

Dodson also grants my central point but a single paragraph, says nothing at all about the inconsistency in dates for Piltdown 2, and argues only that the series of slips should be seen as a *tâtonnement*, or "groping," on Teilhard's part. Dodson merely asserts this interpretation without mentioning the details of a single slip and without even acknowledging my central claim that all the slips have a common theme and thus cannot represent, in my view, a groping to remember the truth.

Von Koenigswald, also treating my central point in one paragraph, ignores the chronological problems of Piltdown 2. (Thus, only one commentator in three even deigns to mention my single strongest argument.) He uses one of Teilhard's subsidiary slips (misstating the year he met Dawson) as evidence of his general forgetfulness, again not acknowledging my claim that all the errors form a pattern, whereas general failure of memory should not yield order. By the way, Professor von Koenigswald is mistaken in stating that Teilhard was "inadvertently dragged into the Piltdown fraud" when he discovered the canine in 1913. Teilhard accompanied Dawson and Smith Woodward during their very first excavation together in 1912. In fact, Smith Woodward had requested that Dawson include no locals in the work, and Dawson had permitted only Teilhard to accompany them, declaring to Smith Woodward that the young priest was "quite safe."

2. Teilhard's silence. Teilhard wrote one short article on Piltdown for a popular journal in 1920, correctly stated that the skull and jaw belonged to two separate creatures, and then proceeded to avoid the subject for the rest of his career. It is the profundity of his silence that I find so startling. Through twenty volumes of collected works, I can find only half a dozen incidental references, either an item in a list, a dot on a graph, or a mention in a footnote—never so much as a single sentence. Yet, as I argued, the Piltdown skull (which, if he was innocent, should have remained a genuine human fossil in his eyes, even if he attributed the jaw to an ape) represented his best argument for a central claim in his evolutionary philosophy—multiple, parallel lineages striving upward toward the domination of matter by spirit. Why did he not use it? He wrote volumes on the legitimate Peking man and at least four review articles on human evolution in general. These articles treat dubious and fragmentary remains, of which Teilhard had no personal knowledge, in detail. Why did he leave Piltdown out if he believed the skull to be genuine?

Since writing my article, I have learned of another small point that makes the silence even more puzzling. When Peking man was discovered, its cranium was reconstructed incorrectly to yield a capacity lying, like Piltdown's, in the modern human range. This unleashed a volume of commentary about the relationship between Piltdown and Peking. Now Teilhard was in China and was contributing (as a geologist) to the original Peking finds. He was the only one there with personal knowledge of Piltdown. Yet, so far as I can tell, he said nothing at all. His own mentor, Marcellin Boule, published a paper comparing the Peking and Piltdown craniums. It included long quotations from Teilhard about the geology of the Peking site, but not a word from him about the craniums.

Washburn again gives this second major claim but a single paragraph, presenting two implausible alternative suggestions to explain Teilhard's silence. First, he conjectures that Teilhard's precarious position with the church may have led him to avoid the controversy. But if Teilhard was playing it safe, why did he write, and circulate extensively in samizdat, the many volumes that the church truly regarded as heretical and enjoined him from publishing—the posthumously printed works that made him a cult figure after his death? Second, Washburn conjectures that Teilhard simply wasn't interested in Piltdown and debates about single fossils, but in a "general philosophy of man." But this makes no sense for two reasons. As I stated above, Piltdown was Teilhard's best empirical argument for this "general philosophy," and he never used it. And if he had so little interest in single fossils, why did he write volumes about Peking man and many review articles about the empirical data of human paleontology—including all the other dubious and problematical fossils. Teilhard was not a man who avoided controversy.

Dodson at least gives my point some space and consideration. He mentions a suite of other human fossils to counter my claim that Piltdown was Teilhard's strongest argument for multiple, parallel lineages. But all these other fossils are consistent with a unilinear phylogeny of *Pithecanthropus*–Neanderthal–modern humans, and many of Teilhard's contemporaries arranged them in just such a scheme (others considered Neanderthal as a side branch). Piltdown was the one clear demonstration of *multiple* lineages, for Piltdown, with its modern skull (literally, as we now know), was the contemporary of big-jawed, beetle-browed Neanderthal.

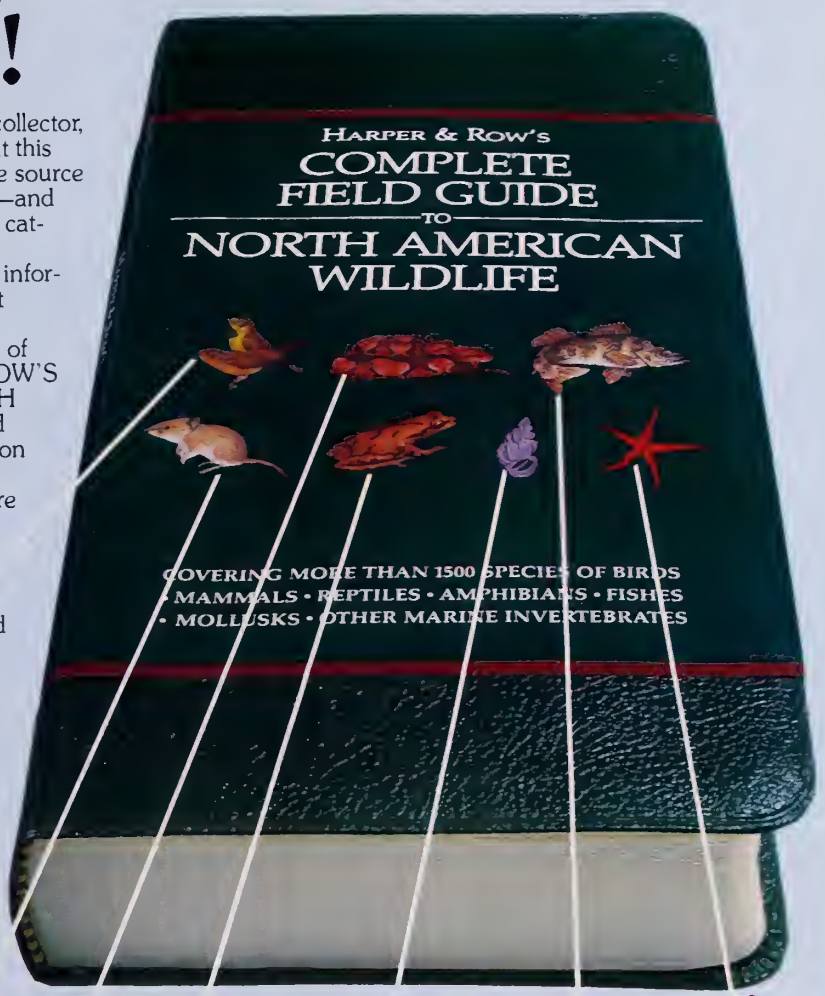
Dodson's alternative explanation for Teilhard's silence is reasonable and I considered it in my article—that Teilhard knew Piltdown was a fake but did not participate in the forgery himself. I agree that Teilhard's extraordinary silence only demonstrates his knowledge or strong suspicion of forgery, not his participation in it. But this is why my case is multifaceted. The silence indicates his knowledge of fraud; had I found this alone, I would not have implicated him directly. It is my other finding—the pattern of slips and later evasions in the letters to Oakley—that seems to me best explained as Teilhard's attempt to cover up an actual involvement. For if he were innocent and only suspicious, why the telling slip in the dating of Piltdown 2 and why a pattern of errors and evasions that seems designed to divert a consideration of his own possible role?

According to von Koenigswald,

NEW: You'd need 7 separate field guides to get all the information in this one!

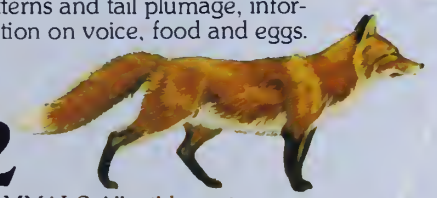
Whether you're a bird watcher, a shell collector, or any lover of the outdoors, you'll want this book with you on every trip. It's the one source on all the commonly observed species—and many of the rare ones—in seven major categories. And for all its completeness, its abundant illustrations and fully detailed information, it's still compact and lightweight enough for your jacket pocket.

Compiled under the supervision of distinguished zoologists, HARPER & ROW'S COMPLETE FIELD GUIDE TO NORTH AMERICAN WILDLIFE is designed and organized for quick and sure identification of species. Its more than 2,000 illustrations by leading natural history artists are carefully painted and printed to reveal key features and true colors. Its sturdy binding, strong bible paper and waterproof vinyl cover make it a rugged as well as a fascinating companion for field or forest, desert, mountain or shore.





1 BIRDS are shown in all their diverse plumages, with close-ups of flight patterns and tail plumage, information on voice, food and eggs.



2 MAMMALS All wild species are covered, including whales, dolphins and other marine mammals. Tracks are shown where appropriate.



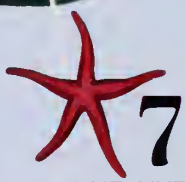
3 REPTILES Coverage includes close-ups that reveal the often subtle color and pattern differences between species. Easily tamed species are noted.



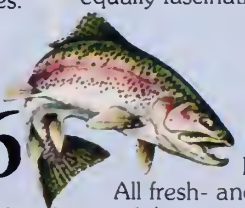
4 AMPHIBIANS are represented by more than 100 species of frogs, toads and salamanders, with details on habits, life-cycles and voices.



5 MOLLUSKS All major groups of commonly found shells are colorfully represented, as well as squids, octopi and other shell-less species.



7 OTHER MARINE INVERTEBRATES include corals, sponges, starfish, crustaceans, jellyfish and many equally fascinating creatures.



6 FISHES All fresh- and saltwater food and game fishes are included, as well as other often-encountered species.

An Alternate Selection of the Literary Guild and the Library of Science, A Main Selection of the Natural Science Book Club, the Birding Book Society, and the Outdoor Life Book Club.

Harper & Row

AVAILABLE IN EASTERN AND WESTERN EDITIONS: $12.95 EACH, AT BOOKSTORES

Teilhard became convinced that Piltdown was two creatures when he came to know Davidson Black and Franz Weidenreich in China, and that this discovery was such a "personal blow" for Teilhard that he loathed the subject of Piltdown ever after. But von Koenigswald's chronology is wrong. Teilhard's 1920 article—published long before he went to China—correctly chose the two-creature hypothesis for the skull and jaw. Of all Piltdown's early discoverers and champions, Teilhard had the least cause for embarrassment. He had never published an enthusiastic comment on the discovery. His only article on Piltdown called it as right as he could without crying fraud (two creatures, mixed together in the same deposit), and he had shut up thereafter.

Washburn apparently prefers the "official" story of Dawson acting alone, my own preference until I found the Oakley letters. Von Koenigswald's attitude is curious. After castigating me in no uncertain terms for my unscholarly willingness to point the finger of blame, he states with more definiteness than I ever imposed upon Teilhard that "the person responsible for the fraud was Professor W. J. Sollas." He then falsely states that I overlooked this proposal and asserts that, had I known of it, my "concoctions would never have been printed." But if Professor von Koenigswald would care to read the first column of my article, he will see that I mentioned the Sollas accusation and dismissed it. True, I did not discuss the point in depth, but my article was long enough and I had already presented a lengthy rebuttal of the Sollas case in my first Piltdown piece (*Natural History*, March 1979).

The Sollas case seems so farfetched to me (and to all others I have contacted who know the details of Piltdown intimately) that I still cannot understand why it attracted so much publicity. It was this incredulity that inspired my first piece. (That article, by the way, did not focus on *whodunit*, but on the subject correctly identified by Washburn as far more important for the history of science in general—why did major scientists ever accept Piltdown.) The Sollas case rests entirely on a tape recording made by J. A. Douglas, the 93-year-old emeritus professor of geology at Oxford (Sollas's successor), just before he died. The professor's case, based on some fifty-year-old suspicions, is idiosyncratic and conjectural. He simply states that Sollas hated Smith Woodward, that Sollas had potential access to bones for the forgery (as did anyone in a major museum and many amateur collectors as well), and that he remembers the arrival of a package of potassium bichromate addressed to Sollas. (This chemical stained the Piltdown bones, but it also had a variety of legitimate uses.) No evidence links Sollas with Dawson or ever places him at Piltdown.

Dodson offers the entire smorgasbord of other possibilities. He also mentions Sollas and the even more unlikely prospect of Grafton Elliot Smith. Ronald Millar's implication of Smith died a quick and well-deserved death after he published it in 1972. Millar grasped at some straws, established no link to Dawson and no evidence for any tie with the Piltdown site. In fact, Smith was the most severely duped and used of all Piltdown's champions. He staked his career on the belief that increase in brain size was a trigger for all subsequent human evolution. A human skull attached to an ape's jaw might have been designed to feed this prejudice, and Smith fell for Piltdown with an ardor unmatched by any other supporter. And lest anyone imagine that he constructed Piltdown to advance his *idée fixe,* Smith was far too subtle a scientist to imagine that he could get away with such a hoax permanently (since any future discovery would destroy him and his thesis forever) and too excellent an anatomist to do such a poor job of forging.

Dodson, to my amazement, even dredges up Butterfield, although my surprise is lessened by Dodson's admission that he hasn't read the accusation itself. The Butterfield story even makes the Sollas case rich by comparison. It is based on nothing more, ironically, than a letter from Teilhard to his parents stating that Butterfield was angry with Dawson for not donating some fossil specimens to his local museum.

Anyone with even the slightest peripheral relationship to Piltdown has been accused by someone or other. People half a world away, people who never knew Dawson, people who never visited Piltdown have been implicated. Teilhard has largely escaped public scrutiny (although he provoked a great deal of private suspicion). But Teilhard was at the site continually. He met Dawson three years before Smith Woodward even heard of the finds. Teilhard and Dawson became friends and prospected together extensively. Why not look close to home, when such a good case is at hand.

In short, none of the three commentators has raised a single substantive point against my thesis. To my knowledge, only one substantive claim has been advanced by anyone, either in public or in private. One of Teilhard's biographers, Mary Lukas, has charged that Oakley and I and all who ever read the Oakley letters have uniformly misinterpreted them. She claims that Teilhard was referring, not to the second Piltdown site—the one Dawson uncovered in 1915—but to a second pit at the first site. But this cannot be because each of three times that Teilhard mentions this second find, he refers to it explicitly as the place "where the two small fragments of skull and the isolated molar were supposedly found in the rubble." Only one place yielded two skull fragments and a molar: the second site, "discovered" by Dawson in 1915.

One final comment, almost as a point of personal privilege: Both Washburn and von Koenigswald (and others in private) have accused me of a particularly distasteful form of nastiness in attempting to tarnish the reputation of a man no longer able to defend himself. Washburn talks of the "reputation of a person long dead who cannot set the record straight." Von Koenigswald, in his covering letter, speaks of my "cheap insult of a dead hero who cannot defend himself." Now, had I suspected Teilhard when he still lived and purposely kept silent awaiting his death, the charges would be well founded. But I was thirteen years old when Teilhard died, and I had never heard of him. The subject of history might as well fold up its tent if it must follow the old motto for eulogies—*de mortuis nihil nisi bonum* ("say only good of the dead"). Most people who ever lived are dead.

The operative sentence of my original article follows, and I see no reason to alter it: "My case is, to be sure, circumstantial (as is the case against Dawson or anyone else), but I believe that the burden of proof must now rest with those who would hold Father Teilhard blameless."

Stephen Jay Gould teaches biology, geology, and the history of science at Harvard University.

hexa·photo·cybernetic
The Possibilities are Endless.



Shutter-Priority: 1000 S 6

Six-mode exposure control. System versatility. Newer electronics for wider applications.



The Canon A-1 is one of the world's most advanced automatic SLR cameras. Combining the finest in optical and mechanical engineering with the most sophisticated electronics, it's technology applied to give you the ultimate in creative control. At the touch of a button.

Depending on your subject, you can choose from six independent exposure modes to achieve the results you want:

1 Shutter-Priority: You select the shutter speed, to freeze the action and prevent camera shake or create an intentional blur. The A-1 automatically selects the appropriate lens opening.

2 Aperture-Priority: Control the area in focus by selecting the lens opening for the effect you want. The A-1 matches with the right speed.

3 Programmed: When you need to shoot fast, just focus. The A-1 will select *both speed and aperture* for great results.

4 Stopped-Down: For extreme close-up or specialized photography, a bellows, a microscope or almost anything can be attached to the A-1. It's still automatic.

5 Flash: Totally automatic flash photography, of course, with a wide variety of Canon Speedlites to choose from.

6 Manual: Yes. For those times when you absolutely want to do it all yourself. To experiment. To explore the possibilities.





There are over forty fine Canon lenses ranging from Fish Eye to Super Telephoto, plus accessories to meet every need. If you can't photograph your subject with a Canon A-1, it probably can't be photographed.

From the sophistication of its LED viewfinder display, to a ruggedness that allows up to five-frame-per-second motor drive, the Canon A-1 represents an incredible technology. At a price that makes owning one a definite possibility.

Canon® A-1

Canon USA, Inc., One Canon Plaza, Lake Success, New York 11042 • 140 Industrial Drive, Elmhurst, Illinois 60126 • 6380 Peachtree Industrial Blvd., Norcross, Georgia 30071 • 123 Paularino Avenue East, Costa Mesa, California 92626 • Bldg. B-2, 1050 Ala Moana Blvd., Honolulu, Hawaii 96814 • Canon Optics & Business Machines Canada, Ltd., Ontario

© 1980 Canon U.S.A., Inc.



Clyde H. Smith

The Virtue of Forests, Virgin and Otherwise

While deforestation continues in the tropics, a few temperate forests are returning. We may need them more than we know

by Hazel R. Delcourt



When a part of North America's remaining forestland is cleared for cultivation, when its trees are felled for timber or ravaged by blight or fire, many people regret the loss of habitat, property, life, and natural beauty. Less often considered but of vital importance is the release of carbon that also results from the loss of vegetative cover. Plants, through photosynthesis, convert carbon dioxide to carbohydrates and can thus store carbon within their tissue. This storage is only temporary, as vegetation ultimately releases carbon back to the atmosphere through decomposition. Forest vegetation accounts for approximately 90 percent of the vast amounts of carbon stored in the biomass of terrestrial ecosystems. Forty percent is currently contained within the temperate and boreal regions of the world. The remainder is concentrated primarily in tropical forests, which typically have greater average biomass and can thus store more carbon. Current concern over the possible global effects of increasing concentrations of atmospheric carbon dioxide must therefore take into account the effects of changing land use on the distribution and cycling of carbon.

Most discussions about the growing problem of atmospheric carbon dioxide center, not on living vegetation, but on fossil fuels (primarily coal, oil, and natural gas—the fossilized remains of photosynthesizing organisms). Since the early 1800s, the ever increasing use of fossil fuels has liberated tremendous quantities of carbon dioxide. The world's oceans and diminished forests cannot provide an endless sink for this carbon, and approximately one-half the carbon dioxide gas produced each year from human activities now accumulates in the atmosphere. With the current rate of increase in the use of fossil fuels, atmospheric carbon could double in as little as fifty years. Many scientists anticipate that as a result, the average global temperature will rise, perhaps by 2°C. The wide range of effects of such a warming could include melting of the polar icecaps and shifts in climatically suitable crop zones.

What many people don't realize is that the amount of carbon released by industry every year is equal to less than 0.5 percent of the total reserve carbon held in vegetation and soil. This implies that relatively small changes in the area or productivity of the world's vegetation can have a great impact, for better or for worse, on the carbon balance. Unfortunately, over much of the earth's surface, soils are currently being degraded and forests cut down at an alarming rate. And deforested areas, in addition to no longer being able to absorb carbon, are themselves sources of carbon. Land clearance in the tropics, for example, which is proceeding at an estimated rate of one percent of the land area every year, may contribute half again as much carbon dioxide as is released by the combustion of fossil fuels. The preservation of all possible reservoirs, or sinks, of carbon has become critical, and detailed studies of the world's temperate forests, to identify areas where intensive forest management can enhance carbon accumulation in the future, may prove of great value.

Inventories of current carbon reserves in temperate forests give us a snapshot of one moment in a long history of forest change. They provide only a static picture of a dynamic process. To place this process in perspective, we need to understand the historical alterations of forest ecosystems that have led to the present distribution of biomass and carbon. Before reconstructing the carbon dynamics of a region, we must estimate the carbon pool existing at the start of the time period being considered. Carbon losses resulting from deforestation and cultivation and carbon gains resulting from reforestation can then be documented. Finally, we can determine the changes in carbon storage, taking into account both losses and gains of carbon through time.

W S Hooks, Archives of the Great Smoky Mountains National Park



J S Coovert, Mississippi Department of Archives and History



Once we establish this trajectory of change, we can use it as a guide to predicting and controlling future trends.

The landscapes of the southeastern United States, extending westward from Delaware to Arkansas and southward to Louisiana and Florida, have undergone major modification in the past 250 years. And although other regions differ with respect to the details of land use, the transformations in this region exemplify the overall trends in carbon storage in the temperate zone.

In pre-Columbian times, the Southeast was covered with a diverse mosaic of forest communities, interspersed with some prairielike openings created by Indian burning and by locally dry or nutrient-poor soils. Using an early inventory of forest resources prepared in 1883 by botanist C. S. Sargent, director of the Arnold Arboretum at Harvard University, we can derive average biomass and carbon values for the original forests remaining in the 1880s. These uncut forests, representative of presettlement conditions, generally attained a greater biomass than many commercial forests reach today, in part because present-day exploitation of marketable timber is continual and in part because certain dominant forest types, and even species, no longer exist.

If we envision the presettlement vegetation of the Southeast as being in a state of equilibrium with natural disturbances such as fires and windthrows, we can use the period from A.D. 1700 to 1750 as a beginning point for considering changes in vegetation. With the coming of European settlers, forests east of the Mississippi River were increasingly opened up for cultivation and exploited for building materials and fuel. Fragmentation of the forests closely followed patterns of settlement in the 1700s. By 1790, most of the Atlantic seaboard was extensively settled, particularly the lowland tidewater regions of Virginia and the Carolinas. Portions of the lower Mississippi Valley were also settled early, with the wide levees of the Red and Mississippi rivers cleared first for the production of sugar cane. Settlement of the interior of the Southeast proceeded along valleys between the Appalachian and Cumberland mountains, until the discovery of gaps in the Cumberlands permitted settlers to transport their families and belongings over the mountains. The frontier receded rapidly as the population grew, with settlements reaching western Louisiana and Arkansas by 1840.

The Industrial Revolution and accompanying mechanization accelerated the pace of destruction of the southeastern forests. Before the end of the eighteenth century, William Dunbar, a plantation owner in the Tunica Hills of Mississippi and Louisiana, combined the use of the cotton gin, introduced in 1793, and the principle of contour farming. The western Florida parishes of southeastern Louisiana quickly became a major cotton-producing area. In the early 1800s, railroad lines were established to connect plantations along tributaries to the Mississippi River, and the export of cotton increased. By the 1850s, the stretch of fertile hills from Natchez,





In about 1700, forests in the southeastern United States and other parts of eastern North America began to recede. Trees were felled for many purposes, including the clearing of land and the gathering of building materials and fuel. As recently as the 1920s, the tanning industry in the Great Smoky Mountains used the bark of hemlock trees, far left, leaving the logs to rot once they had been stripped. Increased mechanization quickened the pace of forest destruction, and by the end of the last century, many lumbering operations, such as the sawmill in Greenville, Mississippi, left, were served by railroads. George Inness's 1855 painting The Lackawanna Valley, *below, shows clearly how the combined impacts of settlements, cultivation, and railroads reduced the vast forests to little more than patchy remnants.*

National Gallery of Art, Washington

With the introduction of the cotton gin in 1793, cotton yields went up, putting pressure on the forests. By 1850, plantations along the lower Mississippi River had replaced native magnolia and beech trees.

Mississippi, to Saint Francisville, Louisiana, produced some of the greatest cotton yields in the South. One result of increased cultivation of the land was a rapid change in forest cover and composition. As plantations expanded, majestic forests of giant magnolia (*Magnolia grandiflora*) and beech (*Fagus grandifolia*) trees, recorded in the first land surveys of the area, were replaced by open fields.

By 1850, the federal government was conducting an agricultural census every ten years. Using decennial census data, we can estimate the proportion of land remaining in virgin forest, that in cultivation, and that reverting to secondary forest. These records show that a major decrease in forest area occurred between 1750 and 1850 in the South. By 1880, less than 35 percent of the Southeast remained in virgin forest, concentrated for the most part in the southern Appalachian Mountains, the Mississippi River bottomlands, the Ozark and Ouachita mountains of Arkansas, and the Gulf Coastal Plain pinelands. Beginning in the 1890s, the remaining tracts of virgin timber in the southern Appalachians and the Gulf Coastal Plain were exploited for lumber, turpentine, and shipbuilding. Some wooden structures from this era, made from the valuable and decay-resistant heartwood of virgin longleaf pine (*Pinus palustris*), are still standing on the coastal plain.

Some forest recovery had occurred after the Civil War as the average size of farms decreased and sharecropping increased. The resultant old-field succession on abandoned land led to the development of secondary forests in the southeastern United States. In the Piedmont of Georgia, for example, up to 30 percent of the land area reverted to forests at this time. Even with this partial recovery of secondary forests in the Piedmont, however, the net result of removal of virgin forest, together with cultivation, erosion, and impoverishment of the soil, was a pronounced depletion of carbon reserves.



Don Nugent

To transport the cotton produced on the fertile southern plantations, steamboats plied the Mississippi. Plantations not situated directly along the waterway delivered their cotton to the river by railroad.

Lithograph by Currier and Ives of William Walker's 1883 *Cotton Plantation*, The Historic New Orleans Collection



On average, between 1750 and 1950 the southeastern United States released 0.13 petagrams (1 petagram = 10^{15} grams) of carbon each year. During this period, the area lost a total of 28.2 petagrams of carbon from the oxidation of vegetation and soil carbon.

Replenishment of carbon reserves did not begin until the mid-1900s, when conservation and forest-management practices started to take effect. The U.S. Forest Service, created in 1928, conducts intensive inventory and management of remaining forest resources. Virgin forests currently occupy less than one percent of their former area in the Southeast, persisting only in small, isolated stands. Upland old-field succession and intensively managed, commercial forest holdings, however, have continued to add to the amount of biomass in the vegetation. In the Piedmont area, where the boll weevil epidemic of the 1920s led to the abandonment of much farmland, regeneration of the pine forests has been particularly extensive. Today, about 95 percent of all forest tracts in the Southeast are categorized as commercial forest and are under direct Forest Service supervision. Forest Service practices of restocking and selected harvesting, which make possible the control of species composition and stand density, have resulted in a net gain in biomass and carbon on these lands since the 1950s. Consequently, as its forests capture carbon dioxide and convert it to wood, the Southeast today serves as a net sink for carbon. This region, representing 15 percent of the world's temperate forest area, illustrates the potential for counterbalancing the effects of continued deforestation elsewhere.

Proper forest management, with an eye to approaching the upper limits of forest growth and hence maximum carbon gain, also necessitates vigilance against disease. For example, when the American chestnut (*Castanea dentata*), a dominant canopy species in the southern Appalachians at the turn of the century, succumbed to blight in the 1920s, the result was a major change in forest composition and biomass. Originally distributed along the Appalachian mountain chain from Massachusetts to northern Georgia, chestnut trees once attained a height of up to 115 feet and a diameter at breast height of 8.5 feet. Reaching largest size and greatest abundance in the mountains of eastern Tennessee and western North Carolina, this species once occupied up to 60 percent of the forest canopy. Tragically, a fungal parasite (*Endothia parasitica*) accidentally introduced from Asia in the early 1900s in a shipment of nursery stock was responsible for widespread die-off of mature chestnut trees. By 1925, this blight had spread into the southern Appalachians, and today, only stump sprouts of chestnut persist, rarely reaching reproductive maturity. The oaks and other hardwoods that have replaced chestnut in the Appalachians are smaller in stature than their predecessors. Recovery and regrowth of forest stands after major alterations, such as logging and blight, is a slow process. Decades of protection from continued lumbering would be required for the regeneration of a forest of giant oaks, yellow poplar, and other hardwoods comparable in biomass to the massive chestnut trees.

The balance between carbon source and carbon sink is clearly sensitive to changes in forest composition and land use. If the current gains in carbon storage in the Southeast are to be sustained, the area of managed, commercial forests and their high productivity must be stabilized or even increased. An economic policy that maintained greater net growth than harvest would further enhance the capability of southeastern forests to gain carbon.

This capability is currently threatened, however, by active deforestation of the southern bottomland forests. The Mississippi Valley, once densely forested with tupelo gum (*Nyssa aquatica*) and bald cypress (*Taxodium distichum*), is one of the largest regions in the Southeast with great potential for accumulating biomass and carbon through forest regeneration. The fertile bottomlands along the Mississippi and other river systems in the Southeast, however, are now being rapidly converted to crop production, particularly of soybeans. The Forest Service estimates that at current rates of conversion, most of the remaining

Forest History Society



The American chestnut, devastated by blight in the early 1900s, was once a dominant species in the southern Appalachians. The present forest of smaller trees has less biomass and can store less carbon.

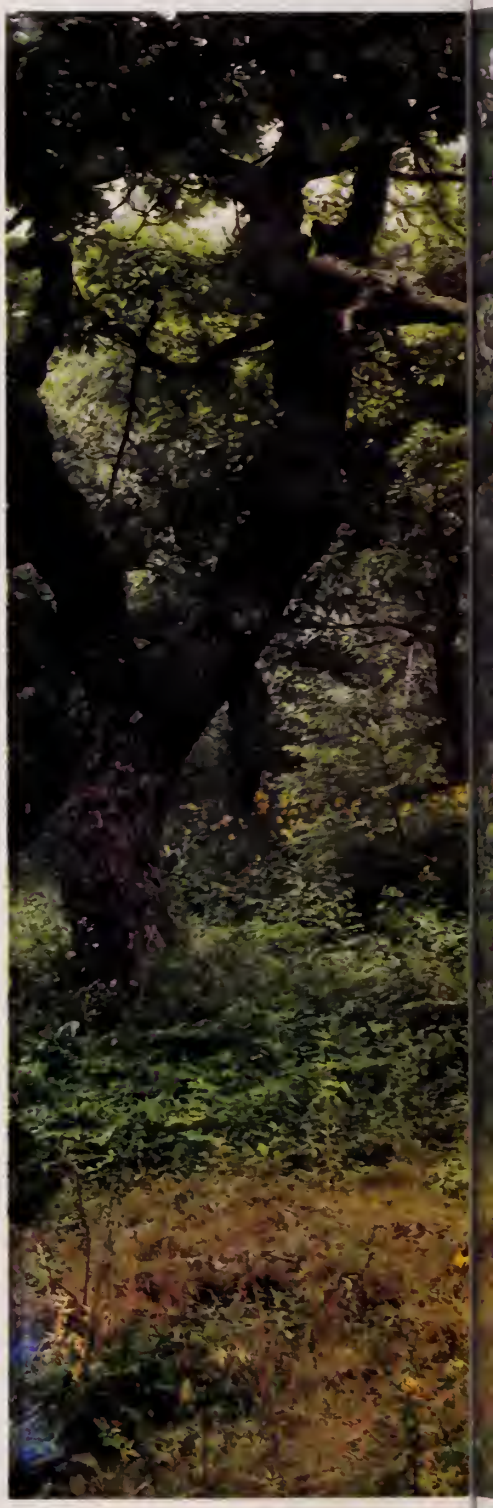
bottomland swamps in the Southeast will be drained, deforested, and planted in soybean fields by 1990. If, over the next several decades, the productivity of commercial forests remains at 1977 levels and the land area now occupied by virgin forest remains constant but the area of secondary forest decreases by as much as 10 percent, then the southeastern biota could return to being a source for atmospheric carbon. Even if the bottomland forests continue to be cut, continued reforestation of unused cropland in other portions of the region might compensate for the loss.

The historical patterns of change in the carbon cycle in the Southeast have been repeated elsewhere in the eastern United States, with certain regional differences. Between 1700 and 1850, the rates of carbon loss paralleled settlement patterns, with the most rapid and intense losses occurring within the original thirteen colonies. Between 1850 and 1900, farm abandonment and reforestation in New England—particularly Massachusetts, Rhode Island, and Connecticut—followed the initial land clearance, creating a temporary sink for carbon there.

In the area of the Midwest extending from Minnesota to Ohio, the magnitude and rate of carbon loss was greatest between 1850 and 1900. In the Great Lakes region, the logging of valuable stands of white pine (*Pinus strobus*) was succeeded by severe slash fires that liberated great quantities of carbon over a relatively short period of time. The depletion of soil carbon that resulted from such fires, for example, in the north of Michigan's Lower Peninsula, reduced soil fertility on sandy outwash plains, thereby prolonging forest recovery.

From 1900 to 1950, loss of carbon was widespread and rapid throughout the East, but overall, since 1950, the eastern United States has been a carbon sink, with only heavily agricultural states continuing to lose carbon each year. A wedge of low carbon values extends from Iowa and northern Missouri into Illinois, Indiana, and Ohio, corresponding to the cultivated land of the Corn Belt. Elsewhere in the East, recovery has been substantial. Furthermore, this trend toward carbon gain has been occurring during the last three decades throughout the temperate region of the Northern Hemisphere. An analysis of forest inventory data from the United States, Canada, Europe, and Asia, by T. V. Armentano of the Institute of Ecology and C. W. Ralston of Duke University, has shown that this current temperate-zone carbon sink has amounted to between 20 and 60 percent of the annual carbon released from the combustion of fossil fuels. Thus, forest recovery in the temperate zone has apparently at least slowed the increase in atmospheric carbon dioxide caused by the combustion of fossil fuels and the deforestation of the tropics.

The forests of eastern North America, which were a carbon source for most of the past 250 years, constitute 25 percent of the forests in the world's temperate zone and are at present one of the principal carbon sinks in that zone. But the levels of atmospheric carbon continue to rise. Regional studies of changing land-use patterns illustrate the spatial and temporal complexities involved in the storage and the exchange of carbon between the atmosphere and vegetation and soil. As we gain an appreciation of the magnitude and direction of the changes, we are beginning to develop a basis for sound management of forests, which play such an important role in the global carbon cycle. □



The forests of North America, such as this oak woods in North Carolina's Pisgah National Forest, make up a quarter of the world's temperate forests. Preservation of these carbon reservoirs must be part of any effort to slow the rising levels of carbon dioxide in the atmosphere.

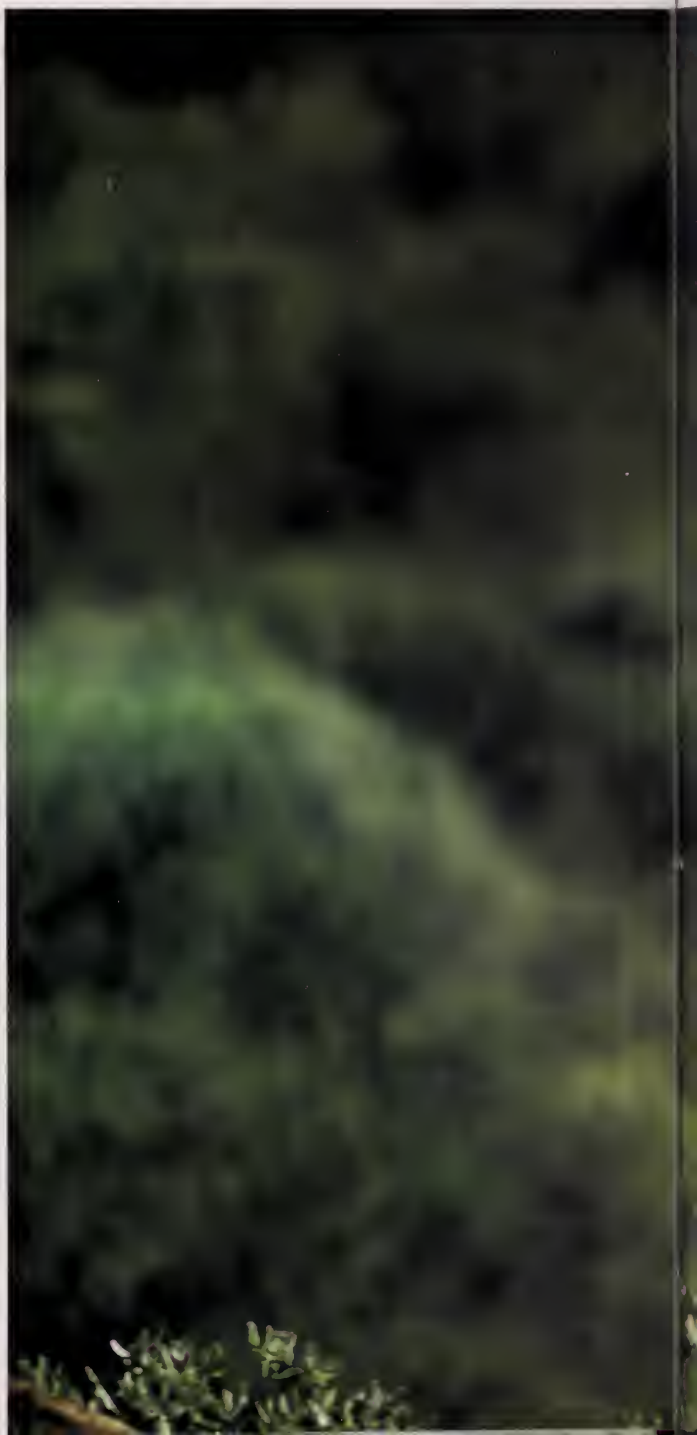


William A. Bake

Spain's Imperial Eagle

Photographs by José Luis González





The Spanish imperial eagle (Aquila heliaca adalberti) *is among Europe's most handsome and most endangered birds. An estimated sixty pairs survive in Spain, primarily in Cáceres Province and in the Coto Doñana National Park, Andalusia, and a few pairs remain in Portugal. Spain has granted the eagle full legal protection, and healthy chicks are born every year, but the birds are still subject to pesticides and other poisons, hunters, and loss of habitat, notably to the planting of eucalyptus.*

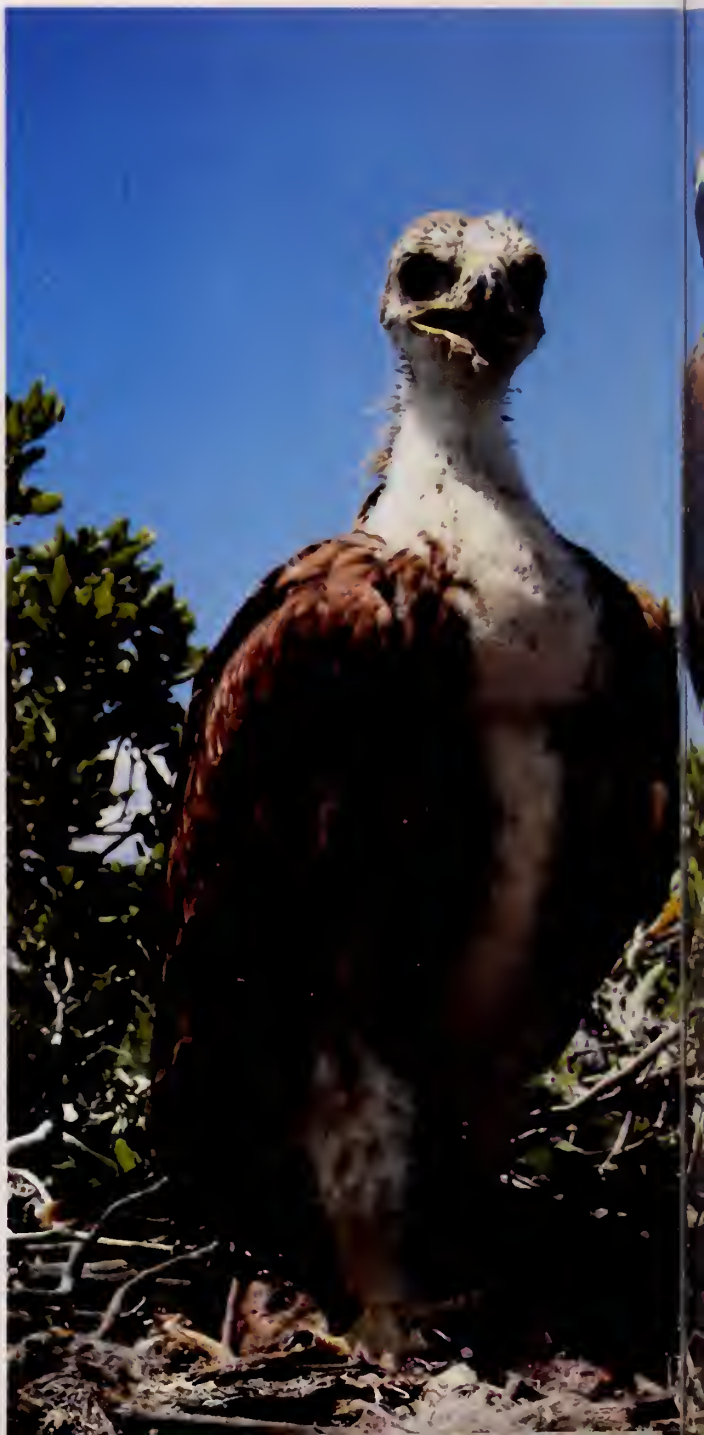
The preferred habitat of the Spanish imperial eagle is savanna with scattered trees for nesting or sparse lowland forest. Forest clearance is forcing the birds closer to human activities, where their habitual fearlessness of humans increases their vulnerability. Mated pairs are monogamous and apparently stay together year-round. Parents share the task of building the nest and incubating the eggs. Both parents also bring back food for the young birds, although the female does most of this work. The male may refuse to deliver food to a disturbed nest site, waiting in a nearby tree for the female to collect it. Birds, small mammals (such as rabbits and hares), carrion, and an occasional reptile make up the bulk of the diet of both nestlings and adults.

Grande



Although the young birds are able to tear at prey by the time they are about five weeks old, they also continue to feed directly from the parent's bill until they fledge at about nine weeks.





Up to four chicks may hatch in a single brood, and a pecking order is soon established among the nestlings. The parents partition food among the young birds until late in the nestling period, but sometimes only one chick, usually the eldest and strongest, survives. The nestlings, often several days apart in age, lose their white down as they grow and acquire juvenile plumage. They are completely feathered by the time they are eight weeks old. The chick (left) is clearly the youngest; the other, older chicks sport more of the darker feathers typical of immature plumage. The young birds will not develop full adult plumage until they are three or four years old, but they may pair and breed before that time.

Once they have fledged, juveniles stay near the nest for two to three weeks, sometimes roosting in the nest itself. Adult Spanish imperial eagles appear to tolerate the presence of young of the same species within the nesting territory. Immature birds eventually disperse, generally remaining on the Iberian Peninsula but occasionally crossing the Strait of Gibraltar into Morocco.





Young Traders of Northern Nigeria

In Hausa society, where women live in strict Muslim seclusion, children play an active and indispensable economic role

Text and photographs by Enid Schildkrout



Thirty years ago, Erik Erikson wrote that "the fashionable insistence on dramatizing the dependence of children on adults often blinds us to the dependence of the older generation on the younger one." As a psychoanalyst, Erikson was referring mainly to the emotional bonds between parents and children, but his observation is a reminder that in many parts of the world, adults depend on children in quite concrete ways. In northern Nigeria, children with trays balanced on their heads, carrying and selling a variety of goods for their mothers or themselves, are a common sight in villages and towns. Among the Muslim Hausa, aside from being a useful educational experience, this children's trade, as well as children's performance of household chores and errands, complements the activity of adults and is socially and economically significant.

Children's services are especially important to married Hausa women, who, in accordance with Islamic practices, live in purdah, or seclusion. In Nigeria, purdah is represented not so much by the wearing of the veil but by the mud-brick walls surrounding every house or compound and by the absence of women in the markets and the streets. Women could not carry out their domestic responsibilities, not to mention their many income-earning enterprises, without the help of children, who are free from the rigid sexual segregation that so restricts adults. Except for elderly women, only children can move in and out of their own and other people's houses without violating the rules of purdah. Even children under three years of age are sent on short errands, for example, to buy things for their mothers.

Hausa-speaking people are found throughout West Africa and constitute the largest ethnic group in northern Nigeria, where they number over eighteen million. Their adherence to Islam is a legacy of the centuries during which Arabs came from the north to trade goods of North African and European manufacture. The majority of the Hausa are farmers, but markets and large commercial cities have existed in northern Nigeria since long before the period of British colonial rule. The city of Kano, for example, which was a major emporium for the trans-Saharan caravan trade, dates back to the eighth century. Today it has a population of about one million.

Binta is an eleven-year-old girl who lives in Kano, in a mud-brick house that has piped water, but no electricity. The household includes her fa-



The northern Nigerian city of Kano, which dates back to the eighth century, has a population of about one million. Reflecting the Islamic custom of keeping married women in seclusion, mud-brick walls surround every house or compound.



Two girls carrying bowls of cooked food stop to talk in the street. Free from the rules of purdah, children move in and out of their own and other people's houses. Women depend on them to sell food or other goods prepared at home.

ther and mother, her three brothers, her father's second wife and her three children, and a foster child, who is the daughter of one of Binta's cousins. By Kano standards, it is a middle-income family. Binta's father sells shoes, and her mother cooks and sells bean cakes and *tuwo*, the stiff porridge made of guinea corn (*Sorghum vulgare*), which is the Hausa staple. Binta described for me one day's round of activities, which began very early when she arose to start trading.

"After I woke up, I said my prayers and ate breakfast. Then I went outside the house to sell the bean cakes my mother makes every morning. Soon my mother called me in and asked me to take more bean cakes around town to sell; she spoke to me about making an effort to sell as much as I usually do. I sold forty-eight bean cakes at one kobo each [one kobo is worth one and a half cents]. After I returned home, some people came to buy more cakes from me. Then I went out for a second round of trading before setting out for Arabic school. I study the Koran there every morning from eight to nine.

"When school was over, I washed and prepared to sell *tuwo*. First my mother sent me to another neighborhood to gather the customers' empty bowls. I also collected the money from our regular customers. My mother put the *tuwo* in the bowls and told me the amount of money to collect for each. Then I delivered them to the customers.

"On my way home, a man in the street, whom I know, sent me on an errand to buy him fifteen kobo worth of food; he gave me a reward of one kobo. I then sold some more *tuwo* outside our house by standing there and shouting for customers. When the *tuwo* was finished, I was sent to another house to buy some guinea corn, and one of the women there asked me to bring her one of my mother's big pots. The pot was too heavy for me to carry, but finally one of my brothers helped me take it to her.

"When I returned, my mother was busy pounding some grain, and she sent me out to have some locust bean seeds pounded. She then sent me to pick up three bowls of pounded guinea corn, and she gave me money to take to the woman who had pounded it. The woman told me to remind my mother that she still owed money from the day before.

"When I came home I was sent out to trade again, this time with salt, bouillon cubes, and laundry detergent in small packets. Afterward I prepared some pancakes using ingredients I bought myself—ten kobo worth of flour, one kobo worth of salt, five kobo worth of palm oil, and ten kobo worth of firewood. I took this food outside to sell it to children.

"My mother then gave me a calabash of guinea corn to take for grinding; my younger sister also gave me two calabashes of corn to take. The man who ran the grinding machine advised me that I should not carry such a large load, so I made two trips on the way back. He gave me and my younger brothers, who accompanied me, one kobo each.

"I was then told to take a bath, which I did. After that I was sent to visit a sick relative who was in the hospital. On the way I met a friend, and we took the bus together. I also bought some cheese at the market for five kobo. I met another friend on the way home, and she bought some fish near the market for ten kobo and gave me some. I played on the way to the hospital. When I got home,





Having purchased a supply at the market, two girls arrange kola nuts for resale according to size and quality. The nuts, chewed as a stimulant by adults, are kept fresh by a moist piece of burlap laid in the tray.



I found the women of the house preparing a meal. One of them was already eating, and I was invited to eat with her.

"After nightfall, I was sent to take some spices for pounding, and I wasted a lot of time there. The other children and I went to a place where some fruits and vegetables are sold along the street. We bought vegetables for soup for fifty kobo, as my mother had asked me to do. By the time I got home it was late, so I went to sleep."

Binta's many responsibilities are typical for a girl her age. Like many women, Binta's mother relies upon her children in carrying out an occupation at home. Although purdah implies that a woman will be supported by her husband and need not work, most Hausa women do work, keeping their incomes distinct from the household budget. Women usually cook one main meal a day and purchase their other meals from other women. In this way they are able to use their time earning a living instead of performing only unpaid domestic labor.

Among the Hausa, men and women spend relatively little time together, eating separately and, except in certain ritual contexts, rarely doing the same things. Differences in gender are not as important among children, however. In fact, it is precisely because children's activities are not rigidly defined by sex that they are able to move between the world of women, centered in the inner courtyard of the house, and the world of men, whose activities take place mainly outside the home. Children of both sexes care for younger children, go to the market, and help their mothers cook.

Both boys and girls do trading, although it is more common for girls. From the age of about five until marriage, which is very often at about age twelve for girls, many children like Binta spend part of every day selling such things as fruits, vegetables, and nuts; bouillon cubes, bread, and small packages of detergent, sugar, or salt; and bowls of steaming rice or *tuwo*. If a woman embroiders, children buy the thread and later take the finished product to the client or to an agent who sells it.

Women in purdah frequently change their occupations depending on the availability of child helpers. In Kano, women often trade in commodities that can be sold in small

quantities, such as various kinds of cooked food. Sewing, embroidery, mat weaving, and other craft activities (including, until recently, spinning) are less remunerative occupations, and women pursue them when they have fewer children around to help. Unlike the situation common in the United States, where children tend to hamper a woman's ability to earn money, the Hausa woman finds it difficult to earn income without children's help. Often, if a woman has no children of her own, a relative's child will come to live with her.

Child care is another service children perform that benefits women. It enables mothers to devote themselves to their young infants, whom they carry on their backs until the age of weaning, between one and two. Even though women are always at home, they specifically delegate the care of young children to older ones. The toddler moves from the mother's back into a group of older children, who take the responsibility very seriously. Until they are old enough, children do not pick up infants or very young children, but by the age of nine, both boys and girls bathe young children, play with them, and take them on errands. The older children do a great deal of direct and indirect teaching of younger ones. As soon as they can walk, younger children accompany their older siblings to Arabic school. There the children sit with their agemates, and the teacher gives them lessons according to their ability.

Much of a child's activity is directed toward helping his or her par-



Children too young to be entrusted with the care of infants often imitate the way women carry babies on their backs. The six-year-old above has a doll, but other children improvise with pillows or bits of firewood.



While washing clothes at home, a woman keeps her infant in close physical contact, safe from such dangers as livestock or fire. After children are weaned, older children are expected to help with their care.

ents, but other relatives—grandparents, aunts, uncles, and stepmothers—and adults living in the same house as servants or tenants may call on a child for limited tasks without asking permission of the parents. Like other Muslims, Hausa men may have up to four wives, and these women freely call on each other's children to perform household chores. Even strangers in the street sometimes ask a child to do an errand, such as delivering a message, particularly if the chore requires entering a house to which the adult does not have access. The child will be rewarded with a small amount of money or food.

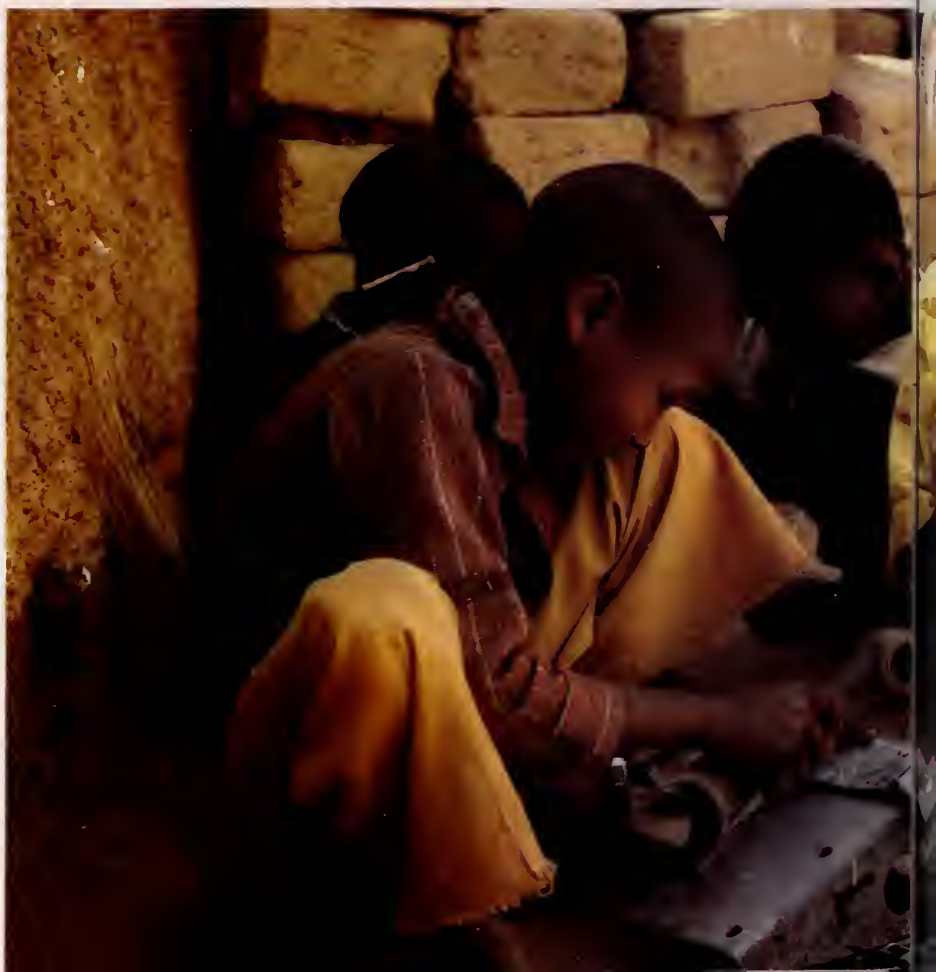
Adults other than parents also reprimand children, who are taught very early to obey the orders of grown-ups. Without ever directly refusing to obey a command, however, children do devise numerous strategies of noncompliance, such as claiming that another adult has already co-opted their time or simply leaving the scene and ignoring the command. Given children's greater mobility, there is little an adult can do to enforce compliance.

Besides working on behalf of adults, children also participate in a "children's economy." Children have their own money—from school allowances given to them daily for the purchase of snacks, from gifts, from work they may have done, and even from their own investments. For example, boys make toys for sale, and they rent out valued property, such as slide viewers or bicycles. Just as women distinguish their own enterprises from the labor they do as wives, children regard the work they do for themselves differently from the work they do on behalf of their mothers. When Binta cooks food for sale, using materials she has purchased with her own money, the profits are entirely her own, although she may hand the money over to her mother for safekeeping.

Many girls begin to practice cooking by the age of ten. They do not actually prepare the family meals, for this heavy and tedious work is primarily the wives' responsibility. But they do carry out related chores, such as taking vegetables out for grinding, sifting flour, and washing bowls. Many also cook food for sale on their own. With initial help from their mothers or other adult female relatives, who may give them a cooking pot, charcoal, or a small stove, children purchase small amounts of ingredients and prepare various snacks. Since they



Older children do a lot of direct and indirect teaching of younger ones. Here, a boy who attends primary school demonstrates at home how to write in English, using chalk on the cement pavement of the courtyard.



Children make most of their own toys, and sometimes sell them to other children. With the author as a steady customer, these boys set up a "company" to manufacture toy cars, trucks, and airplanes from tin cans, bottle tops, and plastic box tops.





sell their products for less than the adult women do, and since the quantities are very small, their customers are mainly children. Child entrepreneurs even extend credit to other children.

Aisha is a ten-year-old girl who was notoriously unsuccessful as a trader. She disliked trading and regularly lost her mother's investment. Disgusted, her mother finally gave her a bit of charcoal, some flour and oil, and a small pot. Aisha set up a little stove outside her house and began making small pancakes, which she sold to very young children. In three months she managed to make enough to buy a new dress, and in a year she bought a pair of shoes. She had clearly chosen her occupation after some unhappy trials at street trading.

In the poorest families, as in Aisha's, the profit from children's work goes toward living expenses. This may occur in households that are headed by divorced or widowed women. It is also true for the *almajirai*, or Arabic students, who often live with their teachers. The proceeds of most children's economic activity, however, go to the expenses of marriage. The income contributes to a girl's dowry and to a boy's bridewealth, both of which are considerable investments.

The girl's dowry includes many brightly painted enamel, brass, and glass bowls, collected years before marriage. These utensils are known as *kayan daki*, or "things of the room." After the wedding they are stacked in a large cupboard beside the girl's bed. Very few of them are used, but they are always proudly displayed, except during the mourning period if the husband dies. *Kayan daki* are not simply for conspicuous display, however. They remain the property of the woman unless she sells them or gives them away. In the case of divorce or financial need, they can provide her most important and immediate source of economic security.

Kayan daki traditionally consisted of brass bowls and beautifully carved calabashes. Today the most common form is painted enamel bowls manufactured in Nigeria or abroad. The styles and designs change frequently, and the cost is continually rising. Among the wealthier urban women and the Western-educated women, other forms of modern household equipment, including electric appliances and china tea sets, are becoming part of the dowry.

The money a young girl earns on her own, as well as the profits she brings home through her trading, are invested by her mother or guardian in *kayan daki* in anticipation of her marriage. Most women put the major part of their income into their daughters' *kayan daki*, as well as helping their sons with marriage expenses. When a woman has many children, the burden can be considerable.

For girls, marriage, which ideally coincides with puberty, marks the transition to adult status. If a girl marries as early as age ten, she does not cook for her husband or have sexual relations with him for some time, but she enters purdah and loses the freedom of childhood. Most girls are married by age fifteen, and for many the transition is a difficult one.

Boys usually do not marry until they are over twenty and are able to support a family. They also need to have raised most of the money to cover the cost of getting married. Between the ages of eight and ten, however, they gradually begin to move away from the confines of the house and to regard it as a female domain. They begin taking their food outside and eating it with friends, and they roam much farther

Hausa women usually engage in some form of enterprise; most of their profits are invested in their children's marriage expenses. Working at home, a woman, right, weaves a mat for sale. This woman is a co-wife to the woman shown with her daughter, below right. As Muslims, Hausa men may have up to four wives, who often call on one another's children to perform household chores. The young girl carrying a tray on her head, below, has small quantities of goods for sale—bouillon cubes and packets of salt, sugar, and detergent. Children usually trade on behalf of their mothers or other adults but they may also earn money from their own small investments.





than girls in their play activities. By the onset of puberty, boys have begun to observe the rules of purdah by refraining from entering the houses of all but their closest relatives. In general, especially if they have sisters, older boys spend less time than girls doing chores and errands and more time playing and, in recent years, going to school. Traditionally, many boys left home to live and study with an Arabic teacher. Today many also pursue Western education, sometimes in boarding school. Although the transition to adulthood is less abrupt for boys, childhood for both sexes ends by age twelve to fourteen.

As each generation assumes the responsibilities of adulthood and the restrictions of sexual separation, it must rely on the younger members of society who can work around the purdah system. Recently, however, the introduction of Western education has begun to threaten this traditional arrangement, in part just by altering the pattern of children's lives.

The Nigerian government is now engaged in a massive program to provide Western education to all school-age children. This program has been undertaken for sound economic and political reasons. During the colonial period, which ended in the early 1960s, the British had a "hands-off" policy regarding education in northern Nigeria. They ruled through the Islamic political and judicial hierarchy and supported the many Arabic schools, where the Koran and Islamic law, history, and religion were taught. The British discouraged the introduc-

tion of Christian mission schools in the north and spent little on government schools.

The pattern in the rest of Nigeria was very different. In the non-Muslim areas of the country, mission and government schools grew rapidly during the colonial period. The result of this differential policy was the development of vast regional imbalances in the extent and level of Western education in the country. This affected the types of occupational choices open to Nigerians from different regions. Despite a longer tradition of literacy in Arabic in the north, few northerners were eligible for those civil service jobs that required literacy in English, the language of government business. This was one of many issues in the tragic civil war that tore Nigeria apart in the 1960s. The current goal of enrolling all northern children in public schools, which offer training in English and secular subjects, has, therefore, a strong and valid political rationale.

Western education has met a mixed reception in northern Nigeria. While it has been increasingly accepted for boys—as an addition to, not a substitute for, Islamic education—many parents are reluctant to enroll their daughters in primary school. Nevertheless, there are already many more children waiting to get into school than there are classrooms and teachers to accommodate them. If the trend continues, it will almost certainly have important, if unintended, consequences for purdah and the system of child enterprise that supports it.

Children who attend Western school continue to attend Arabic school, and thus are removed from the household for much of the day. For many women this causes considerable difficulty in doing daily housework. It means increased isolation and a curtailment of income-producing activity. It creates a new concern about where to obtain the income for children's marriages. As a result of these practical pressures, the institution of purdah will inevitably be challenged. Also, the schoolgirl of today may develop new skills and new expections of her role as a woman that conflict with the traditional ways. As Western education takes hold, today's young traders may witness a dramatic change in Hausa family life—for themselves as adults and for their children. □



Shakespeare–The Poet's Worlds

by S. Schoenbaum

In 1592 the playwright Robert Greene, dying in miserable squalor, lashed out, in his *Groatsworth of Wit, Bought with a Million of Repentance*, at a successful professional rival who—lacking even a university degree!—had the impudence to fancy himself "the only Shake-scene in a country." This is our first record of Shakespeare in London. He was then twenty-eight and had been in the capital long enough to establish himself and attract envious notice. Some years earlier, then, he had boldly set out from Stratford-upon-Avon on the high road to London, a hundred miles distant.

What had possessed him to pull up stakes and leave behind—for the time—his wife and three small children? In an early play, *The Taming of the Shrew*, Petrucchio speaks of "such wind as scatters young men through the world / To seek their fortunes further than at home, / Where small experience grows." Some such wind carried Shakespeare from the little Warwickshire town of his origins to a London overflowing the ancient city walls: a magnet for foreign visitors, hub of the publishing trade, and—above all, for him—the center of theater. But Stratford had nurtured him, and unlike some of his literary colleagues, he never severed his provincial ties.

As a child plying his textbooks through the unmercifully long Elizabethan school day, he must have turned whenever possible to another, more seductive book. This was the book of nature open to him in the gardens, orchards, and hedgerows of leafy Stratford, along the Avon's banks, and in the beckoning fields and woodlands just outside. "Flowers I noted," the poet says in Sonnet 99, and in fourteen brief lines, the forward violet, the lily, the buds of marjoram, and the roses standing fearfully on thorns all find their place. Shakespeare's works constitute a brilliantly colored garden in which flowers, wild and cultivated, blossom side by side.

Along the river's bank the young Shakespeare would have noticed sedge, rushes (used to strew the floors of Tudor houses), and the tall reeds that thatched the roofs of humble cottages. In the stream the green leaves of the vagabond flags swayed to and fro in "the varying tide," while the willow trees growing along the water's edge cast their gray reflection. Traditionally, the willow symbolized forsaken love. Desdemona sings a song of willow before she dies, and in perhaps the most famous floral passage in Shakespeare, willow frames the scene of Ophelia's drowning.

If Shakespeare's works are a scented garden that invite the horticulturist's interest, they hold, too, the pleasures



All illustrations from the Folger Shakespeare Library

"Shakespeare: The Globe & the World," a special exhibition from the collection of the Folger Shakespeare Library in Washington, D.C., will be on view at the American Museum of Natural History from June 18 to September 20. This article is adapted from the catalog to the exhibition, Shakespeare: The Globe & the World, *by S. Schoenbaum, © 1979 by the Folger Shakespeare Library, published by Oxford University Press in association with the Folger Shakespeare Library.*



Shakespeare's birthplace in Stratford-upon-Avon was painted in 1834 by Phoebe Dighton.

A hand-colored woodcut of a fallow deer appears in Edward Topsell's Historie of Foure-footed Beastes *(London, 1607). A legend originating after Shakespeare's death has him poaching such deer on the grounds of Sir Thomas Lucy's estate, four miles upstream from Stratford.*



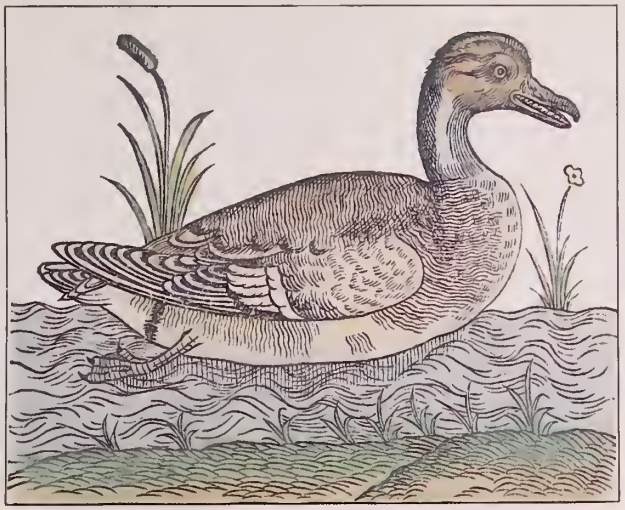
of the arboretum. Shakespeare names, among others, elm, pine, box, ash, oak, and aspen. The oak, although vulnerable to lightning, betokens strength; Coriolanus, in the Watch's words, is "the rock, the oak not to be wind-shaken." In all, Shakespeare's plant inventory comprises more than 150 varieties, according to one tabulation.

Bird references, while less numerous, occur often enough to keep a drowsy ornithologist awake. They include birds of prey and carrion (eagle, kite, raven, vulture, and owl), as well as game birds (woodcock, partridge), waterfowl (swan, wild goose, loon, dive-dapper, and mallard), and such familiar songsters as the blackbird, redbreast, and thrush. For his birdlore, as has often been noted, Shakespeare also draws upon inherited typologies: the phoenix rises from its ashes; the pelican feeds her young with her own blood.

Some of the other creatures the young Shakespeare would have encountered on, or near, his Warwickshire doorstep were the harmless, necessary cat; the farmer's dog barking at the beggar; the "breeding jennet, lusty, young, and proud" that "rushes, snorts, and neighs aloud." On neighboring farms, such as the one his Uncle Henry worked in Snitterfield, Shakespeare would have seen the livestock with their offspring. Poor Wat, the relentlessly hunted hare in *Venus and Adonis*, is part of a vernal world Shakespeare fondly evoked. Outrunning the wind, turning and crossing, bounding through gaps in hedges and fences, he reaches the illusory safety of the hilltop where he "stands on his hinder legs with list'ning ear,/To hearken if his foes pursue him still." The poet's sympathies notwithstanding, Shakespeare may well have hunted. Certainly other high-spirited youths of Warwickshire did so, and the plays and poems yield a sufficiency of knowledgeable allusion.

London offered different attractions. There Shakespeare acted, as well as wrote plays for his acting company. During his idle hours he could plunge into the life of the town. London, which conferred no degrees, became his university, providing the nonacademic context for that knowledge of the human heart, unrivaled in range and depth, which for many remains the most astonishing aspect of the Shakespearean achievement. Around him he could see a fair city full of folk and observe the inexhaustible pageant of everyday life.

Shakespeare saw the country folk come to town with their wares, on foot or in their carts, and he heard the market bell ring. To Grace Church Street, husbandmen brought corn and malt to sell at their standings in the great corn market, situated there since the Middle Ages.



The duck and the owl are depicted in Pierre Belon's L'Histoire de la Nature des Oyseaux *(Paris, 1555), a French naturalist's early attempt at bird classification. While taking cues from nature, Shakespeare also drew on legendary associations and birdlore, such as the belief that shrieking night owls bode ill, especially at a birth.*



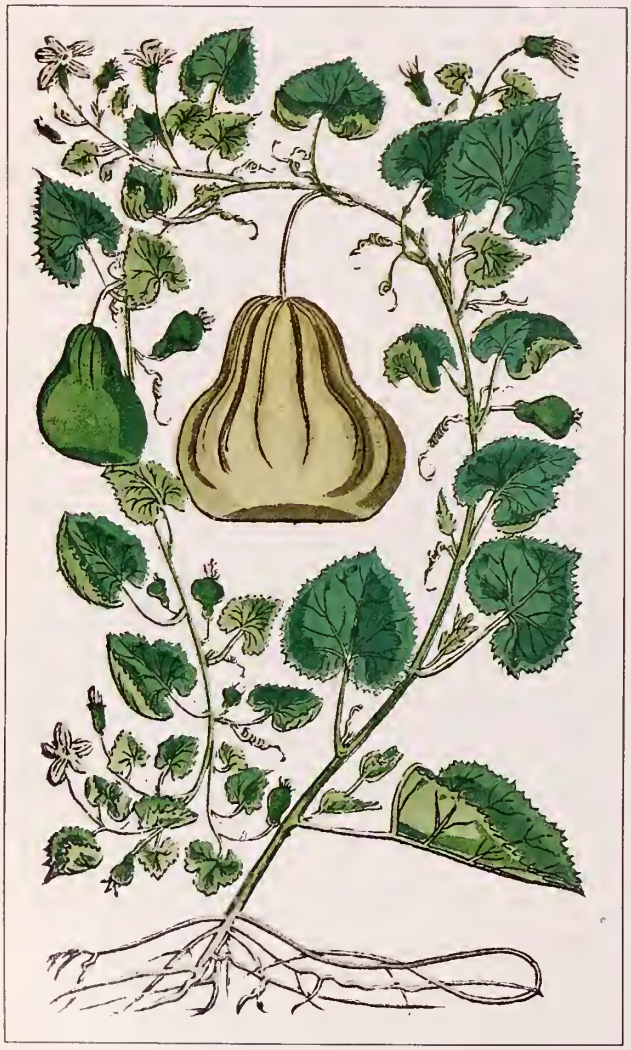
The Stocks, in Cornhill Ward, were a marketplace for flesh and fish. Billingsgate, one of the main city wharves, also offered freshly caught fish, but not until much later—in 1696—did Parliament allow a daily market there. A small portion of Smithfield was reserved, as in times past, for marketing horses and cattle. Bakewell Hall, in the little ward of Bassings Hall, was immemorially "employed as a weekly marketplace for all sorts of woollen clothes broad and narrow, brought from all parts of this realm, there to be sold." Farmers fetched their poultry to Leaden Hall Market, where other commerce went on as well.

Tradesmen and sellers of wares kept shops everywhere: mercers and haberdashers on London Bridge, goldsmiths in Cheapside, pepperers and grocers in Bucklesbury, drapers in Candlewick Street, skinners in Bridge Row, stockfishmongers, cooks, and ironmongers in Thames Street, poulterers in Grace Street, while "the brewers for the most part remained near to the friendly waters of the Thames." In the old days the bakers of London were enjoined to sell no bread in shops or houses: only in the market in Bread Street. Such centralization had long since vanished in the wake of urban growth, but in a regulated economy nothing is more stringently controlled than the price and quality of the daily bread. Elizabeth's Privy Council still enforced the "statutes and ancient customs for making and retailing of all lawful sorts of bread."

In Elizabethan England, the Crown sought also to curb excess in apparel, but not very successfully. The fashionable reveled in luxurious materials (silks and velvets from Italy and France) ornamented with precious jewels. But if the upper classes consumed conspicuously, and the mercantile classes with balance-sheet moderation, many in this period lacked any means at all. They wore rags.

High- and low-born, whether in tatters or finery, people thronged to the capital. Of the magnets drawing the hurrying folk, one or two are especially conspicuous. Fronting the Cornhill stood the gigantic emporium that Sir Thomas Gresham, a mercer of London, had commissioned Flemish architects to build in imitation of the great Bourse at Antwerp. In the cloistered piazza of the Exchange, merchants gathered to conduct their affairs while above, in the Pawn, tradesmen—milliners, haberdashers, armorers, apothecaries, glass-sellers, and the rest—carried on their retail businesses in shops illuminated by wax-lights. Here one went for a mousetrap, a birdcage, a shoehorn, or a lantern. At the

A finely illustrated botanical book, or herbal, available in Shakespeare's time, was Den Nieuwen Herbarius *(Basel, 1550), from which this hand-colored picture of a gourd is reproduced. The author of* The New Herbal *was German botanist Leonhard Fuchs, after whom the fuchsia was named.*



Royal Exchange, Mammon had his London temple.

If one preferred God, Saint Paul's beckoned, although Mammon had established a foothold there too. To the Middle Aisle of Paul's, called Duke Humphrey's Walk, repaired the Westminister crowd—courtiers, wits, and gallants-about-town—to strut in their finery, observe and be observed. Lawyers, stationed at their pillars, received clients; wenches, masks clapped to their faces, arranged assignations. Meanwhile, divine services went on. In Paul's churchyard flourished the book trade—a relatively new industry. In the outpourings from the presses, Shakespeare found the literary sources for his comedies, histories, and tragedies.

Shakespeare also caught glimpses of the real world of intrigue and pomp, which as his history plays testify, he came to understand so well. That was when his troupe was summoned to Richmond or Greenwich or Whitehall—wherever Elizabeth kept her court—to participate in the festivities of the Christmas season.

Although the London panoramas tease rather than satisfy curiosity, they give us an inkling of what the Globe (and other bankside amphitheaters) looked like from the outside. We see the surrounding shrubbery and tenements; we see the competing arena in which chained and blinded bears were tormented by hungry dogs for the amusement of holidaymakers; and in the near distance, we see the silver-gliding Thames. The London theaters, each with an estimated capacity of some 3,000 spectators, were among the principal attractions of the metropolis for foreign visitors.

On 29 June 1613, during a performance of Shakespeare's *Henry VIII*, the thatched roof on the Globe playhouse caught fire, a wind fanned the flames, and within two hours the theater was reduced to rubble. Miraculously, no lives were lost. A year later the second Globe opened its doors to the public on the same site. This time the roof was prudently tiled. Shakespeare may well have decided that this was an opportune time to bid adieu to the multitudes who, for over two decades, had applauded his plays and rewarded him with material success. So he retired at twilight to New Place, the pretty house of brick and timber he had acquired in Stratford. Presumably, Shakespeare there cultivated his garden, which was celebrated for its vines.

On 25 April 1616, he was laid to rest in Holy Trinity Church where, fifty-two years earlier, he had been christened. Thus did he begin and end his days in Stratford. In between, London had provided a stage for supreme achievement. □

Although the Crown sought to curb excess in apparel, fashion enjoyed a renaissance in Elizabethan England. Below, a courtier and his lady are depicted in an anonymous watercolor sketch from the time of James I, the successor to Elizabeth I.





Peaceable Peccaries

Much snuggling and nuzzling enable these relatives of wild pigs to maintain cooperative and cohesive herds

by John A. Byers

In 1683, an anatomical account of a New World mammal was published in the *Philosophical Transactions* of the Royal Society of London. The beast had been brought alive to England and when it died was given to Dr. Edward Tyson for examination and dissection. Tyson had in hand a male of a species known today as the collared peccary, *Tayassu tajacu*. His wonderfully descriptive name for the animal was the Mexico musk-hog. Spanish explorers of the time also knew the animal and referred to it as the javelina (from the Spanish *jabalina*, or "spear," a reference to the animal's large canine teeth).

The collared peccary is one of three extant species in the family Tayassuidae. The tayassuids diverged from the true pigs, or Suidae, in the early Oligocene, about 40 million years ago, and differ from true pigs in several important respects. Like pigs, however, peccaries possess a tough, disk-shaped snout and have a proclivity to root. Although they were once cosmopolitan, peccaries are confined today to the New World. The collared peccary occurs over a huge range between Argentina and the American Southwest; its close relatives, the white-lipped peccary and the chacoan peccary, are found only in the tropics and subtropics. In the United States, collared peccaries occur in the southern regions of Texas, New Mexico, and Arizona.

Peccaries and pigs differ in many ways. To begin with, the former are much smaller: collared peccaries are about three feet in length, stand about a foot and a half at the shoulder, and weigh about fifty pounds; wild boars (from which domestic pigs were derived) may weigh up to ten times as much. The coats of peccaries are composed entirely of large, coarse bristles; those of pigs vary, but in general they have hair as well as bristles, the latter being more scattered, shorter, and less robust than the bristles of peccaries. Pigs have a simple stomach; peccaries have a multichambered stomach resembling that of the ruminants in form and, somewhat, in function. Pigs have rather primitive feet; peccaries have more specialized feet that show adaptations for running. The canine teeth of pigs curve outward, as in the wart hog; those of peccaries are straight and interlocking. Finally, the two groups differ with respect to litter size and social organization. Pigs give birth to large litters of small, relatively helpless young; mothers spend much time alone caring for their young in a nest or den; and there are no permanent social groups. Peccaries do have permanent social groups and females bear litters of only two young, which are able to walk soon after birth. As a result, mothers are able to rejoin their herd quickly.

I studied peccaries on the 3-Bar Wildlife Area, a sixty-square-mile research preserve maintained by the Arizona Department of Game and Fish. I was drawn to the collared peccary because, in the literature, there were tantalizing intimations that the species was highly social. A major goal of my earlier research had been to discover whether specific types of early experience lead to specific types of adult behavior in animals. More generally, what developmental strategies does each species use to achieve its level of social organization? This is, of course, a huge question, and one way to begin attacking it is to look for broad patterns at the ends of the spectrum of social organization, that is, in highly social and in nonsocial species. My intimations that peccaries would be at the high end of the spectrum turned out to be correct.

The social unit of peccaries is a cohesive herd, composed of equal numbers of males and females. This reflects a sex ratio at birth of 1:1 and the fact that individuals rarely disperse into new areas. Herd size in the American Southwest, and throughout Central America and South America, in those areas where reliable counts have been made, averages twelve to fifteen members. There is essentially no sexual dimorphism. Within herds, animals remain close to each other, and individuals become visibly upset and may utter loud, squalling cries if they lose contact with their fellows. Herds therefore act as a unit in which all individuals move, feed, and rest together.

Each herd occupies an exclusive home range about one square mile in size. Within each home range a network of peccary trails connects feeding locations and traditional resting sites, or bed-grounds. The animals give the strong impression that they possess a detailed "cognitive map" of the home range: when undisturbed, their movements are deliberate, and they choose energetically efficient paths (by angling up a hill rather than attacking it head-on or by contour-

Lyle K. Sowls

Kenneth W. Fink, Photo Researchers



Snuggling in their afternoon bed-ground, two peccaries typify the close contact maintained by these animals. The herd to which these peccaries belong will use another site for its nighttime bed-ground.

ing around the head of a canyon rather than crossing directly by going down and then up). Obviously, the animals know, in some sense, their destination (whether a bed-ground or a feeding ground) and they take the most efficient, but usually not the most direct, route to get there.

Herds also seem to know when they are near the borders of their home ranges. At these times, the peccaries increase the rate of deposition or secretion from their large dorsal gland, a scent organ present in both sexes that lies on the midline of the back, just anterior to the tail. Tyson made much of the dorsal gland in his 1683 article and, after examining in a withering fashion the hypotheses of his contemporaries that the structure was a second navel, a mammary gland, a urinary orifice, an intestinal orifice, or a spiracle for breathing, he correctly identified it as a scent gland.

But what is most particular in our *Hog*, and makes the greatest wonder; and differences it, from any other Animal I know of in the World; is the *Teat* or *Navill* or *Foramen* rather on the hinder part of the back. All who mention this *Animal*; look on this, as a thing so extraordinary, and uncommon; that I know not how their amazement has so far clouded their reason, as to betray them into most extravagant Conjectures, and opinions concerning it.

Scent marking is probably the way in which adjacent herds define the boundary between their home ranges. This seems plausible because the rate of actual interactions between herds is extremely low; in a year of field observations I saw herds come together only twice. In one of these instances, there was a flurry of short chases back and forth, then both herds drifted apart and bedded down within 1,000 feet of each other. In the other, the same two herds were together, feeding peacefully along the border between their home ranges when I found them; they slowly fed and ambled in separate directions.

I tested the idea that scent marking might be important in boundary definition by erecting fence posts at quarter-mile intervals along a ridge where the home ranges of three herds met. Peccaries investigated the posts but did not mark them. I then collected dorsal gland secretions from a captured member of a herd five miles away and placed it on the posts. Residents responded to this new odor by marking on top of it, often with such vigor that I could smell the posts from some distance and could see dorsal gland secretion dripping from them. This result suggested that peccaries recognized an unfamiliar dorsal gland scent and re-marked it to indicate that the area was occupied.

The dorsal gland, besides being used in scent marking, figures prominently in a cooperative social action I call the "mutual rub": two animals approach each other and stand side by side so that each rests its head against the other's rump; each then vigorously rubs the side of its head up and down over the other's rump and dorsal gland. This activity lasts about five seconds, and no doubt smears the oily secretion of each partner's dorsal gland onto the head and back of the other. Peccaries also spend much time nuzzling each other and lying in close contact—two activities that further promote the transfer of the secretion. The overall result is that each animal becomes an effective broadcaster of the dorsal gland scent, so much so that when herds were directly upwind from me, I could sometimes detect them by smell. This suggested to me that peccaries, with their keen sense



of smell, use a "cloud" of dorsal gland scent that surrounds each herd as a cue to judge their distance from the herd's center. Vision is certainly less important. Peccaries have notoriously poor eyesight and, if the wind is right, will blunder to within a few feet of an unconcealed, but motionless, person before taking flight.

Hearing may be the most important orienting mechanism. On several occasions I was very close to feeding herds as they drifted past me, and each time I was impressed by the sounds that envelop a feeding herd: the click of hoofs on rocks, the crunching and smacking sounds of chewing, and the periodic low grunting all herd members make. The low grunt is a repetitive flat sound, similar to the grunts made by pigs. Lost peccaries emit the sound almost constantly and appear to listen for a return call; they quickly approach animals in the vicinity that respond. Thus, group cohesion seems to be promoted primarily through hearing and olfaction.

Why do collared peccaries stay close together and why is vision not an important means of doing so? The species probably evolved from other peccaries in the Pliocene rain forests of South America. Predation by large cats is today, and no doubt was then, a serious threat, constituting a selective pressure strong enough to cause individual peccaries to bunch together. In the dense rain forest understory, these low-slung beasts would have had trouble using vision to keep in contact with each other, but they could have used sounds and smells (to which vegetation is more "transparent") to do so. Bird watchers are familiar with this phenomenon. In thick vegetation, far more birds can be heard than seen.

The tendency for peccaries to stay close together is so strong that most individuals probably never leave the herd into which they are born. As a result, herds most likely comprise a group of closely related animals. This, in turn, has probably been responsible for the evolution of the highly cooperative behavior that herd members extend toward each other. (Chacoan and white-lipped peccaries also live in herds, and white-lipped groups can exceed 200 individuals. Essentially nothing is known about the constancy of herd composition or social behavior in these two species.)

Cooperative behavior among peccaries can be crucial in winter. In central Arizona, winter nights are usually chilly and sometimes downright cold. On one memorable morning at the 3-Bar, the temperature before the sun rose was 17°F, and there was a light covering of snow that capped the saguaros and made them seem to shiver. Peccaries are typical tropical mammals. Because they have no heat-retaining wooly undercoat, peccaries quickly begin to expend extra energy to maintain a constant body temperature when they are exposed to cold. As a result, in the winter they are diurnal, moving and feeding during the day. Huddling together on winter nights is essential if the animals are to stay alive. (As summer nears, peccaries become increasingly nocturnal, moving and feeding at night and resting in a shaded bed-ground throughout the day.)

One typical winter morning, I arrived at a vantage point above a herd's bed-ground before sunrise and before the animals were up. Rustling amid the turbinella oaks began as the sun appeared, and soon stretching, yawning, and shaking animals drifted into view. There was a concentrated bout of mutual rubbing between herd members, then the animals began to move in a rough single file from the bed-ground. They traveled only a short distance until, reaching a sunny spot, they began to feed.

During the winter much of the highly nutritious food on which peccaries usually depend, such as acorns, bulbs, mesquite beans, and cactus fruit, is unavailable, and for several months the animals may subsist al-

most entirely on prickly pear cactus. Lyle Sowls, leader of the Arizona Cooperative Wildlife Research Unit, has shown that captive peccaries can survive for several months on prickly pear alone but that they eventually deteriorate on such a diet. The plant is important for the animals because it sustains them through the lean winter period. The pads, or cladophylls, of the prickly pear cactus, with their long spikes and tufts of spines, do not seem to be inviting food items, yet the peccaries, with apparent disregard for the spines, attack them with impunity. Occasionally, individuals will worry a pod loose from the plant, then paw at it as if to break off some spines. More frequently, they simply approach a plant and bite directly into it.

In the herd I was observing, feeding animals remained close together and often several individuals fed side by side from the same plant. Occasionally, squabbles broke out when one animal approached and began to feed next to another, but more frequently the animals simply fed together peaceably. In many instances, two animals were able to approach and feed so close to each other that their snouts almost touched. Juveniles, in particular, were able to approach adults and feed mouth to mouth with them. Juveniles even snatched food dangling out of the mouth of an adult without suffering retribution.

After a bout of intensive feeding, the herd began to travel rapidly in a particular direction, with animals feeding in a more choosy and desultory fashion. Moving and feeding continued until between 10:30 and 11:00 A.M., by which time the herd had traveled approximately a half mile from where it started and was nearing another bed-ground. As is often the case, this site was surrounded by a radiating network of trails, and when the animals encountered a trail, they quickly moved onto it and walked steadily toward the bed-ground.

As the animals entered the bed-ground a striking event took place: all herd members began to play in a wild and comic manner. Such play bouts are frequently started by juveniles, but most adults participate in them. Mutual chasing around a bush and one peccary flopping on the ground to mock bite with a partner standing over it were particularly common. My favorite play action involved one animal running full-tilt downhill toward another lying flopped on its back; the two would clamp jaws, and the running peccary's momentum would carry it sailing over the other, rotating in a slow arc, like a diver in layout position, until it crashed heavily on its side. As is true of their social behavior in general, peccaries show great behavioral diversity while playing. Play bouts lasted about fifteen minutes, and juveniles tended to play longer than adults. Eventually, all animals reclined close together, many lying side by side.

The herd rested for several hours. Individuals got up and fed briefly or changed places to recline next to another herd member or moved in and out of the sun to keep comfortable. Much quiet, amicable behavior, including sniffing, nuzzling, and lying in close contact, could be observed





Jerry Day

Two peccaries perform a "mutual rub." Each rubs its head over the other's dorsal gland. The scent of the gland's oily secretion may aid in judging distance between herd members.

Jerry Day



Prickly pear cactus is an important winter food. The spines of the plant do not deter the peccaries, which simply bite into the pads. Two or more peccaries commonly feed together without dispute.



during this time. When the animals began to move again, they did so rather suddenly. More feeding followed, with the animals moving rapidly. As darkness fell, the herd was close to the bed-ground where it would spend the night.

A day in the life of an individual peccary is thus dominated by feeding, slow movement, and resting, with other animals always close at hand. The day is punctuated by brief feeding squabbles, mutual rubs, and most conspicuously, by play. The single most revealing and important fact about peccary social organization is that the average distance between animals is about ten feet, or three body lengths. Individuals are born into a herd and are literally surrounded by familiar animals throughout their lives. By this criterion alone, peccaries are more social than most other ungulates. Moreover, as I have intimated, they also display a level of cooperation that makes them unique among the hoofed mammals.

Cooperation takes several forms. First, there is some degree of cooperative feeding, or food sharing. This practice may occur between adults, but it is especially prevalent between adults and juveniles. All juveniles are apparently given carte blanche by all adults, and juveniles are not in the least hesitant to use their special status, often aggressively driving an adult from a food source, as well as snatching food from an adult's mouth. Adults could easily dominate juveniles in these encounters, but they do not. This social convention is probably important for juveniles in several ways: it provides for mostly positive social interactions between juveniles and their future peers; it gives juveniles access to high-quality foods; and it probably teaches them what types of plants should be eaten. All adults extend these favors toward *all* young; nonparents are as tolerant as parents.

Feeding interactions illustrate a more general phenomenon: adults are tolerant of juveniles in all respects. In bed-grounds, juveniles clamber over the reclined herd and try to wedge themselves between adults; on trails, they are often able to shoulder adults aside. In one typical instance, two small infants stood beneath an adult's chin and repeatedly snapped at its mouth as it tried to feed. The adult was forced to elevate its snout in order to chew, and in this position it began to walk forward. The juveniles darted between its front legs and caused it to stumble. There was no retribution.

Adults also act cooperatively to protect juveniles from predators. The canine teeth of peccaries in both sexes are long, robust, and self-sharpening since the back of the bottom canines slide against the front faces of the teeth on top. Adult peccaries do not tolerate coyotes or bobcats. They quickly drive them away, while often ushering juveniles in another direction. The response of herds to humans, and probably to large predators such as bears or mountain lions, is different. Here there is no attempt at defense; the animals simply run away. If the disturbance is mild enough (as when the herd picks up the scent of a distant human observer), there is a well-organized retreat, with one or two adults

Jerry Day



Rubbing its dorsal gland against a rock face, this peccary is scent-marking a boundary site of its herd's home range. Neighboring herds seldom mark over each other's scent deposits.

in the lead, followed in single file by the juveniles, then the rest of the adults. If the disturbance is more immediate (as when the observer blunders into the midst of a herd), the animals tend to scatter in all directions in an every-peccary-for-itself manner. This set of strategies makes sense. If defense or organized retreat is possible, it is carried out. If the danger is so large and imminent that defense would be futile, the herd's scattering may tend to confuse a predator. It also would tend to draw attention away from the helpless juveniles, which in these situations seek some kind of cover and remain motionless. Herds quickly regroup after a disturbance, individuals using the low grunt to locate one another.

A third form of mutual assistance is cooperative nursing. Unlike females in most ungulate species, peccary females will allow young other than their own to nurse. Juveniles approach from the rear and suckle while the female stands. Females do not turn around to check the identity of these young, and it seems that most young are able to nurse from most females that have milk. On several occasions in herds that had many new young, there was a snapping, jostling horde of hungry young at the rear end of one female. There were obvious injustices—with larger young pushing smaller ones aside—but the nursing females continued to munch cactus complacently, as if the storms behind them did not exist. Milk production in mammals is an energetically expensive business, and females of most species usually make sure that they give milk only to their own young. In many ungulates, females will not tolerate an alien juvenile in their vicinity while they are nursing. I thus found it striking that peccary females seem to distribute milk indiscriminately.

Peccaries are also unusual mammals in that males do not compete actively for mating rights. When a female is in estrus, there may be a slight increase in aggressive behavior, but more often than not, pairs court and mate with other males quite close by. On one occasion I saw a female mate with one male, then turn and court and mate with another while the first stood idly by. I found it curious that males seem to give up individual reproductive success. The most likely explanation is that the males in a herd are so closely related to each other that for any individual the difference in real reproductive success between a female producing his offspring or the offspring of another male is so slight that it is not worth fighting about. It is not known if inbreeding reveals deleterious recessive genes in peccaries or if there are social mechanisms that preclude matings between very closely related individuals.

The low level of competition between males is also reflected by the lack of sexual dimorphism in peccaries. Males and females are equal in body size, and both sexes have large, sharp canine teeth. In other species that have mating systems in which males fight for access to females, males are usually much larger than females and tend to have large, conspicuous fighting and display structures, such as the horns and antlers in many other ungulates. The lack of sexual dimorphism in peccaries suggests to me that the species has had a substantial evolutionary history of reduced male–male competition.

The collared peccary is thus, by many measures, a highly social beast. The animals in a herd are cohesive and possess two specialized ways of maintaining close contact (the mutual rub and the low grunt). There is cooperative feeding, mutual tolerance of young by all adults, regular play that involves all herd members, cooperative nursing, and reduced male–male competition. The species is close to one extreme of the spectrum of mammalian sociality and was indeed appropriate for my study of behavioral development.

The development of behavior and the nature of early experience in peccaries is another story in itself. The gist of what I found is that in development, as in adult social behavior, peccaries are different from most other mammals. In other highly social species, juveniles interact amicably with each other and in this way probably form the bonds that draw them together as adults. Peccary juveniles barely interact with each other for the first seven months of life and when they do interact, it is likely to be in a fight over access to food or a female's teat. Yet these juveniles eventually grow up to become amicable, cohesive, and cooperative adults. Adult tolerance of juveniles is probably vital in this species, and juveniles seem to be brought into the social group via their interactions with adults, not their interactions with each other. There are intricacies in this process that I will try to sort out in future field seasons. □

The 1981 Rolex Awards For Outstanding Enterprise

The Rolex Awards for Enterprise is an international program to provide financial help and special encouragement for individuals whose projects have broken new ground in their chosen fields. These projects capture that spirit of enterprise which has been such a characteristic of the development of the Rolex watch. Here are the five award winners of 1981 with a resume of their projects.



A Blueprint for Disarmament — Seymour Melman

If global disarmament ever is to be achieved, one vital step in the process will be to convert industrial economics from military to civilian work. Seymour Melman, an American Professor of Industrial Engineering, has been exploring myriad technical, economic and organizational changes required to make such conversions work.

As industrial economics vary widely, Professor Melman is formulating three representative models for conversion: the U.S.A. and Western Europe, the Socialist countries, and the less-developed countries.

His 1981 Rolex Award for Enterprise will enable Professor Melman to develop his blueprints for conversion.



To Save the Snow Leopard — Rodney Jackson

In the snow-covered Nepalese Himalayas lives the elusive, endangered snow leopard.

Mr. Rodney Jackson, a wildlife biologist, plans to capture live several specimens of these magnificent creatures and collar them with radio transmitters. Very little is known about the snow leopard, but we do know that it faces almost certain extinction as man encroaches upon its habitat.

Mr. Jackson's 1981 Rolex Award for Enterprise will expand our knowledge of the snow leopard and its environment and help save a beautiful species from extinction.



Preserving Mexican Folk Music — Eduardo Llerenas

The culture of Mexican folk music is one of the richest in the world.

However, due to the influence of TV, radio and the record player, it is a culture fast disappearing.

With two companions, Mr. Eduardo Llerenas has made over eighty trips into the remotest parts of Mexico in order to record, compare and preserve the country's traditional songs.

When completed, the work of Mr. Llerenas will provide an accurate and lively record of the folk music of Mexico.

His 1981 Rolex Award for Enterprise will help Mr. Llerenas to complete this valuable undertaking.



Re-fertilizing the Earth — Andre Martin

All over the world, vast tracts of fire-damaged land lie waste. To return land such as this to its original fertility is the aim Andre Martin has set himself. The undergrowth, brushwood and scrub, the only things which will grow on such land, are cleared and converted into an organically rich compost.

In a successful experiment in France, twenty previously desolate acres have been returned to successful cultivation using this method.

His 1981 Rolex Award for Enterprise is reward for Andre Martin's truly fertile imagination.



Let the Sperm Whale Live — Milan Mirkovic

Mr. Milan Mirkovic has devised a novel irrigation method for the growing of the jojoba bush. The jojoba nut contains an oil which is almost identical in properties to sperm whale oil and therefore could become a commercial alternative to sperm whale slaughter.

However, it is only Mr. Mirkovic's use of containers filled with earth and a water absorbent polymer (it holds 1,000 times its own weight of water, thus dramatically reducing the cost of irrigation) which may make the cultivation of the jojoba a commercial possibility. Mr. Mirkovic's 1981 Rolex Award for Enterprise should help in saving the sperm whale.

Each of these five winners has received 50,000 Swiss francs as a contribution to the fulfillment of his work. Each has also received a specially inscribed Rolex Oyster as a tribute.

The 1981 Rolex Awards for Enterprise: Help and encouragement to those who have demonstrated truly outstanding enterprise.

ROLEX
of Geneva



THE MARKET

Art

AMERICAN INDIAN CRAFTS: Pueblo pottery; Hopi 2nd and 3rd Mesa plaques; Kachinas; old and new rugs. No catalogue. One-of-a-kind pieces; individually photographed. Most priced $100/up. Write for photos and data, specifying interests. Box 5896, Sherman Oaks, CA 91413 (213) 789-2559

AUTHENTIC IROQUOIS "Broken Nose" False Face, $90, request photo, McCoy Imports, Liberty, NY 12754

LOST ART REVISITED. Stained Glass Supply Catalogue, $2. Nervo Distributors, Dept. NH, 650 University, Berkeley, CA 94710

OLD NATURAL HISTORY PRINTS—Catesby, Edwards, Audubon, Gould's Hummingbirds; shells, botanicals, animals, insects, etc. Free illustrated catalogue. Portobello Prints, 1649 Hopkins, Berkeley, CA 94707 (415) 549-1676

WHALES—hand-carved pine; blue, humpback, sperm, narwhal. Illustrated brochure $1.00. Doug Lind, P.O. Box 74, Burlington, WI 53105

Book Publishers

AUTHORS, don't invest until you read "My Encounter with Subsidy Publishing." 16 page booklet, $2, Brian D. Rude, Rt. 2, Box 18A, Redfield, SD 57469

PUBLISH YOUR BOOK! Join our successful authors. Publicity, advertising, beautiful books. All subjects invited. Send for fact-filled booklet and free manuscript report. Carlton Press, Dept. NHF, 84 Fifth Avenue, New York 10011

Books

ALFRED de GRAZIA'S CHAOS AND CREATION: An Introduction to Quantavolution in Human and Natural History. Stunning scientific alternatives to Evolution, by a noted professor and social theorist. Just out in Numbered First Edition of 1000, clothbound, $21.00 postpaid. Please send cheque with order to Metron Publications, Box 1213, Princeton, NJ 08540

BOOKFINDING. Librarians search worldwide titles or subjects plus 150,000 indexed stock. PAB, 2918 Atlantic, Atlantic City, NJ 08401 (609) 344-1943

EARLY EXPLORATIONS (includes natural history) Pre-Columbian Art, Archaeology. Bob Fein Books, 150 Fifth Avenue (Rm. 623) NY 10011. Send $1 for catalogue. Hours: 10-5 (Mon-Sat)

OUT-OF-PRINT, SCARCE, Zoology, Botany, Ornithology, Colorplate, etc. Catalogue $1.00. Book Chest, 19 Oxford Place, Rockville Centre, NY 11570

PUBLISHERS' OVERSTOCKS, BARGAIN BOOKS. 2,000 titles, all subjects! Free catalogue: Hamilton, 98-55 Clapboard, Danbury, CT 06810

SOUTH AMERICA BOUND? We've got detailed guidebooks, maps for travellers. Europe, Asia too. Send for free catalogue. Bradt Enterprises, 54-N Dudley, Cambridge, MA 02140

YESTERDAY'S BOOKS LOCATED, no obligation. Out-of-State Book Service, Box 3253J, San Clemente, CA 92672 (714) 492-2976

Business Opportunities

HOW to have your own International Brokerage Business at home for under $150.00. Free Details! Resource Publishing Corporation, Box 4667NH, Philadelphia, PA 19127

Collector's Items

INDIANHEAD & Lincoln Cents, 1880's-1949, 33 Different-$2.99. Bargain Coin Catalogue-25¢. Edel's, Carlyle, Illinois 62231

70-110 YEAR OLD MAPS. All States. Stamp for Catalogue. Northern Map, Dept. HN, Dunnellon, FL 32630

Correspondence

"EARTH FRIENDS" magazine interconnects outdoors and nature lovers USA/worldwide for conservation networking, friendship, adventure. Box 331499N, Miami, FL 33133

MAKE FRIENDS WORLDWIDE through international correspondence. Illustrated brochure free! Hermes-Verlag, Box 110660/NH, D-1000 Berlin 11, West Germany

ORIENTAL WOMEN SEEK CORRESPONDENCE for cultural exchange, language practice, friendship. Asian Exchange, Honokaa, Hawaii 96727

Education

FARRAGUT NAVAL ACADEMIES

A complete academic program: Oceanography, Naval Science, extracurricular activities, sports. Grades 5-12. Separate lower school. Small classes. Honor Naval School. Fully Accredited. Band. Riflery. Sailing. NJROTC. College guidance program. 2 waterfront locations. Write for catalog. *Admits students of any race, color, national or ethnic origin.*

NORTH: Box Z, Toms River, NJ 08753—201 • 349-1121
SOUTH: Box Z, St. Petersburg, FL 33710—813 • 384-5500

EXPLORE MICROSCOPIC WORLD—algae, protozoans, blood cells, etc. New Science Course for all ages. How to purchase and use a microscope with free brochure. Life Sciences, Box 591W, Woodbury, NY 08096

FIELD COURSES IN NATURAL HISTORY. College Credit. Write Aspen Center for Environmental Studies, Box 8777A, Aspen, CO 81612

Employment Opportunities

AUSTRALIA NEEDS YOU! Jobs! Paid Transportation! Newest handbook, $2.00 (guaranteed). Australian International Services, Box 19107-RT, Washington, DC 20036

AUSTRALIA—NEW ZEALAND NEED YOU! Big Pay! 50,000 jobs. Free transportation. Latest listings $2.00. Austco, Box 772, Cypress, CA 90630

AUSTRALIA NEW ZEALAND WANT YOU! 17,500 Jobs! Paid Transportation! New Report! $2—Moneyback Guarantee! "Australia Commission," Department 894-C6, National Press Building, Washington, DC 20045

FREE DETAILS—OVERSEAS JOBS! All occupations! 68 countries. Paid fare. Computerized reports. Jobworld, Box 681, Cypress, CA 90630

OPPORTUNITY that promotes Environmental Harmony, Nutrition, Consciousness for Everyone. Write. Enhance, Box 198, Estherville, Iowa 51334

OVERSEAS—ALL OCCUPATIONS! Worldwide Directory and complete information—$3.00. International Opportunities, Box 19107-RS, Washington, DC 20036

ROCKY MOUNTAIN EMPLOYMENT NEWSLETTER! Colorado, Idaho, Montana, Wyoming! Current openings—all occupations! Free details . . . Intermountain-4Y, 3506 Birch, Cheyenne, WY 82001

TEACHERS - ADMINISTRATORS: School, college job openings: USA, $5.95; Abroad, $5.95. Placement, sources USA, $4.95; Abroad, $4.95. EISF, Box 662, Newton, Massachusetts 02162

Foreign Newspapers

WORLDWIDE ENGLISH NEWSPAPERS. 65 countries including England! Sampler. 5/$2.98. Free Brochure. Multinewspapers, Box DE-206, Dana Point, CA 92629

Gourmet Interests

ECONOMIZE! Elegant ways with chicken. Send $2.95 to Post Office Box 0185, Dept. 3, College Grove Center, San Diego, CA 92115

PIZZA MAGNIFICO. Old time family recipe. $1.00 to Maxine, Box 176, Corbett, OR 97019

SOUTHERN ITALIAN PASTA SAUCES. Family recipes $2.00 SASE to Recipes, G.P.O. Box 1246, Brooklyn, NY 11202

TRADITIONAL GERMAN-SWISS PASTRIES, 2 easy recipes. Send $2.00 SASE to: T. Kilkowski, P.O. Box 504, Carver, MA 02330

Government Surplus

"GOVERNMENT SURPLUS DIRECTORY." Buy 500,000 items (including Jeeps) . . . low as 2¢ on dollar! Most complete information available-$2.00. Surplus Disposal, Box 19107-RS, Washington, DC 20036

JEEPS—$19.30!—CARS—$13.50!—650,000 Items! —Government Surplus—Most Comprehensive Directory Available Tells How, Where To Buy—Your Area—$2—Moneyback Guarantee—"Government Information Services," Dept. DC-6, Box 99249, San Francisco, CA 94109

Merchandise

ATTENTION BEAR LOVERS! 48 page catalogue devoted to bear lovers. Send $1.00 to bear-in-mind, Dept. NH1, 73 Indian Pipe Lane, Concord, MA 01742

NAME TAPES—protect clothing from loss at camp, school or anywhere. $4.00 per 100. Send names to Sterling, P.O. Box 110, Winsted, CT 06098

NEW—200 Page 1981-82 catalogue, listing thousands of chemicals, science equipment and labware. Send $2.00 to Merrell Scientific, Dept. N-H, 1665 Buffalo Road, Rochester, NY 14624

PURCHASE BOWIE, Civil War knives, Indian tomahawks. Robert Abels, 2881 N.E. 33 Court, Fort Lauderdale, FL 33306

WORRIED about diarrhea, food poisoning while traveling? Take activated charcoal capsules. Absorbs irritants safely, effectively. $3.98. Health Yourself, P.O. Box 483, Redan, GA 30074

Miscellaneous

HANDWRITING ANALYSIS BY A PROFESSIONAL. Fascinating and revealing. Send $5.00 and SASE to Amerimail, 203 S.W. 9th Avenue, Portland, OR 97205

IDEAS, INVENTIONS, new products wanted! Write for Kit-NH, IMI, 701 Smithfield Street, Pittsburgh, PA 15222

Old Time Radio

OLD TIME RADIO PROGRAMS on cassette tapes. Free catalogue. Casette Library Center, P.O. Box 5331H, Baltimore, MD 21209

Optics

BINOCULAR SALES AND SERVICE. Repairing binoculars since 1923. Alignment performed on our U.S. Navy collimator. Free catalogue and our article "Know Your Binoculars," published in Audubon Magazine. Mirakel Optical Co., Inc., 331 Mansion St., West Coxsackie, NY 12192 (518) 731-2610

HUGE DISCOUNTS. Nationally Advertised Brands. Binoculars, Spotting Scopes. Orders shipped prepaid. Free price list. Sandan Associates, Box 986, Delray Beach, FL 33444

KALEIDOSPHERE—3 Dimensional kaleidoscope. Polyhedral symmetries reflect spherical images. Encourages creative exploration. Information included. $7.50. KaleidoSphere, P.O. Box 82, Crestone, Colorado 81131

LEITZ, ZEISS, B&L, SWIFT, BUSHNELL, NIKON, Optolyth binoculars, telescopes and accessories. Send stamp for discount list. Specify literature desired. Large stock. Orders filled postpaid day received. Birding, Box 5N, Amsterdam, NY 12010

OPTIC DISCOUNTS: Binoculars—Telescopes—Brand Names—Free Catalogue. Thos. Manetta, 61 Hoffman Avenue, Elmont, NY 11003

Personals

FREE BOOK FOR SINGLE MEN! "How To Meet And Get Dates With Lovely Girls". Southern Heart, Desk 43, Box 1977, Sanford, FL 32771

Photography

PHOTOGRAPHERS. Top professional New York Photographer offering services as photographic consultant by mail to a few amateurs. Individual guidance, based on your photographs and interests, to give your photography meaning and impact. Guy Gillette, 133 Mountaindale Road, Yonkers, NY 10710

"PHOTOGRAPHY IS A VISUAL FEAST." An extremely clear book on taking and developing your own pictures. Send $6.95 to Box 875, Mendocino, CA 95460

Real Estate

FREE! Big Summer Catalogue! Over 5,400 country properties described, pictured! Land, Farms, Homes, Businesses, Waterfront, Recreation, Retirement buys! Selected best thruout the U.S. Over 700 offices, 43 states. All Across America! Yours Free from the World's Largest! Strout Realty, Inc., 60 E. 42nd Street, Dept. 5390, New York, NY 10017

FREE . . . 296-PAGE CATALOGUE. Describes and pictures over 2,800 farms, ranches, acreages, businesses and town and country homes from coast to coast. United Farm Agency, Inc., 612-V W. 47th St., Kansas City, MO 64112. Ph. Toll-Free: 1-800-821-2599, MO. Res. Ph. Toll-Free: 1-800-892-5785

GOVERNMENT LANDS . . . FROM $7.50/ACRE! Homesites, farming, vacationing, investment! "Land Buyer's Guide" plus nationwide listings—$2.00. Surplus Lands, Box 19107-RS, Washington, DC 20036

Rentals

ADIRONDACK LODGES on Upper Saranac Lake. Available for two weeks or a month, July through September. Everything provided for comfortable living in the quiet woods. From $650–$1,700 for two weeks. Please write Bartlett Carry Club, RFD 3, Tupper Lake, NY

HEAVEN: modern, secluded lakeside log home. $260.00; wilderness cabin, $87.00 weekly. Santa Lake, Temple, Maine 04984

ST. CROIX, VIRGIN ISLANDS. 3 BR deluxe house or 2 BR beautiful condominium—luxury vacations, inexpensive. Fromer (212) 442-1827

Resorts

LITTLE ST. SIMONS ISLAND

One of Georgia's "Golden Isles"



Birding, beachcombing, riding, wildlife photography, fishing or just relaxing on a secluded 12,000 acre island with miles of unspoiled ocean beaches, forests and marshes. Over 200 species of birds. Maximum of 10-15 guests at a time. Excellent food and accommodations. Professional naturalists on the staff. **Little St. Simons Island** P.O. Box 1096N, St. Simons Island, GA 31522



Jaipur Market — Doranne Jacobson

ACADIA NATIONAL PARK, efficiencies, small apartments, shore cottage, daily or weekly. AAA, write Cadillac Inn, Bar Harbor, Maine 04609

ADIRONDACK WILDERNESS, sparkling mountain lake, informal, great tennis, food, hiking, horses, family rates. American Plan. Timberlock, Box NH, Indian Lake, NY 12864

ALASKAN WILDERNESS FAMILY invites you to share their coastal wilderness. Sincere, informal hospitality in a spectacular sea and mountain panorama. The place for those desiring quiet solitude; for birders, naturalists, photographers. 30 foot tides, prolific seabird and marine life. Glaciers, nesting eagles, bears, sea otters, seals, whales, untracked beaches, forest trails. Pull in crab and shrimp pots; catch salmon, trout, halibut, dig clams, gather mussels. An in-depth, educational experience. 8 guests only. $1125.00/5 days. Cozy cabins, gourmet meals. Called America's best wilderness lodge. The McBrides, China Poot Bay via Box 956NH, Homer, AK 99603, radio/phone (907) 235-8910. Write for brochure.

NEW MEXICO. Guided tours—wildflowers, birds, prehistoric dwellings. Bear Mountain Ranch, Silver City, NM 88061 (505) 538-2538

TOBAGO, PRIVATE BEACH COTTAGES on working cocoa plantation. Swimming, snorkeling, fishing from your front door. Bird watcher's paradise. Brochure Charles A. Turpin, Charlotteville, Tobago, West Indies

VACATION/RELAXATION—Birdwatcher's delight—Peaceful, secluded nature lover's mountain retreat. Cave Creek Ranch, Portal, Arizona 85632

Tours/Trips

A TRIP OF A LIFETIME. Galapagos and Inca Peru. A small group tour offering individual attention. Two departures for two weeks each: August 12, 1981 and February 1982. Cost $2,698 U.S. per person. Limited space available. For further information contact Wings of the World, Inc. Travel, 653 Mt. Pleasant Road, Toronto, Canada (416) 482-1223

ALASKA TRAVEL ADVENTURES—Experience Alaska in guided intimate group trips. Backpacking, canoeing, kayaking, whitewater rafting, wildlife photography, fishing, custom trips. Alaska-Hawaii Combinations. Free catalogue describes 50 different trips throughout Alaska for all ages and abilities. Contact Alaska Travel Adventures, 499 Hamilton Ave., Suite 212-YY, Palo Alto, CA 94301. In California call collect (415) 329-9013, elsewhere toll free (800) 227-8480

ALASKAN WATER ADVENTURES. Kayaking, Rafting, Birding in Prince William Sound and Copper River Basin. Open Door, Box 1185N, Cordova, Alaska 99574 (907) 424-7466

BE A SPARETIME TRAVEL AGENT, detailed guidebook explains how, profits, travel benefits, $3.95. SAV Travel, Box 571-NH, Hicksville, NY 11802

BIRDS WORLD RECORD: "Explorer's Inn", Amazonas, Peru. Abundant other Fauna/Flora. Forum Travel, 2437 Durant, Berkeley, California 94704 (415) 843-8294

GALAPAGOS/ECUADOR/PERU. Economic guided tours from $1532. 8 to 15 days. Galapagos, all meals. Weekly departures. Options: Ouito, Amazon, Cuzco/Machu Picchu. University credit available. Details: J.A. Colley, LAST, Inc., 43 Millstone Road, Randallstown, MD 21133 (301) 922-3116

GALAPAGOS HIKING AND SAILING EXPEDITIONS. Machu Picchu option. Also exhilarating horseback expedition to Peru and Machu Picchu. Inca Floats, 5982N Balboa, Oakland, CA 94611 (415) 339-9095

HIMALAYAN TRAVEL, INC. Trekking expeditions in the Everest and Annapurna areas of Nepal. Exotic cultures/spectacular mountain scenery. Box 481-NH, Greenwich, CT 06830. Toll Free (800) 243-5330

LEGENDARY CULTURES, FASCINATING NATURE: Special Programs to Latin America and Africa. Groups/Individuals. Also: Europe and China. Forum Travel, 2437 Durant, Berkeley, California 94704 (415) 843-8294

NATIVE SHAMANISM OF SOUTH SEAS. Return to Mu, 28-day wholistic adventure to Hawaii, Fiji, Samoa, Tonga. Unforgettable teaching/living experience with Traditional Villagers. Fall/Spring Departures. Earthlight Productions, P.O. Box 429-N,, Del Mar, CA 92014 (714) 481-5288

NATURALIST GUIDED FIELD SEMINARS and tours, West Texas and Mexico. Rafting, hiking, backpacking, bus. University or Continuing Education credit as appropriate. Write Education Department, Chihuahuan Desert Research Institute, Box 1334, Alpine, TX 79830

NATURE PHOTOGRAPHY field work and instruction in remote, mountain locations throughout the West. Brochure. The Natural Image, P.O. Box 45, Winthrop, WA 98862

NEW ZEALAND WALKABOUT: A selection of escorted nature and hiking tours, featuring New Zealand's scenic National Parks, the Milford Track, Farm Holiday Stay. Pacific Exploration Company, Box 3042-N, Santa Barbara, California 93105

SAVE ON LUXURY CRUISES! (Passenger ship or Freighter) How? Ask TravLtips, 163-09 Depot Road, B516, Flushing, NY 11358

SCOTTISH HIGHLANDS. Wildlife trips weekly April-October. Other wildlife destinations include Shetland, Orkney, Iceland, Tanzania, Canary Islands, Nepal, Texas, Arizona & California, and Alaska. Also backpacking and trekking in Nepal, Peru, Bhutan and Scottish Highlands. Expert leadership. Write: McGregor Travel, 33 Lewis Street, Greenwich, Connecticut 06830, or call: (800) 243-5330

VACATIONS IN NATURAL HISTORY for singles, couples, families—sailing—trekking—birding—photography—research. Blue Sky Adventures, Dept. NH5, Oak Ridge, NY 07438

RATES AND STYLE INFORMATION

$1.75 per word, 16 word ($28) minimum. *Display classified* is $150 per inch. All advertisements must be prepaid. Rates are not structured for agency or frequency discounts. All advertisements are accepted at NATURAL HISTORY's discretion. Send check/money order payable to NATURAL HISTORY to: The Market, NATURAL HISTORY Magazine, Central Park West at 79th St., New York, NY 10024. Please include your personal address and telephone number, issue preferred, and suggested heading. Deadline—8th of month, two months prior to cover date (the January issue closes Nov. 8). Camera-ready art is required for display ads. A tearsheet or copy of the page with your ad will be sent upon publication.

Box numbers, telephone numbers, and hyphenated words count as two words; abbreviations and zip codes as one word each. All states are shown in two-letter code followed by zip, then telephone (with area code), if desired. Occasionally, slight editing is required for clarity. Thank you!

Searching for Dim Companions

Astronomers use a variety of techniques to find the less luminous partners in double star systems

by James W. Christy

The major characteristic of the universe is that it organizes matter into very small packages, thus producing its characteristic appearance in visible light of bright points on a black background. The organizing force is gravity. Gravity has condensed matter from the vastness of space into galaxies, stars, planets, comets, and even smaller bodies. Many of these small bodies are relatively dark objects. Consequently, in addition to the bright points on the black background, there are even more dark points about which we know little. Some are dead stars, notably the postulated black holes. Fortunately, it is possible that black holes, black dwarfs (stars too small to ignite and shine as a result of nuclear reactions), and planets may occur primarily in the presence of visible stars. This is demonstrated in the existence of the planets around our sun and in the existence of double stars, or binary systems, where very small and dim stars sometimes orbit brighter ones. Many binary systems consist of stars of nearly equal brightness, but it is the dim companions that are especially interesting. The frequency of systems with small companions relates directly to our understanding of the formation processes of stars and, furthermore, to the expected frequency of occurrence of systems with extremely small companions, such as planets.

That dim stars are often paired with brighter ones at least eliminates the frustration of searching the entire sky, 535 billion square seconds of arc, when looking for nearly invisible objects. (An arc second is a measurement of how large an object appears to the viewer. It is a small unit that depends on the size and distance of the object. One arc second, for example, is about one eighteen-hundredth of the diameter of the full moon as seen from the earth.) However, this pairing means that many of the objects in the universe may lie very close to other stars, inside the atmospherically caused fuzziness that broadens images seen through earthbound telescopes. The size of such images is normally larger than one arc second. At the distances of most stars, such fuzziness would easily obscure an entire solar system. One might conclude that there is very little one can do to obtain information about these less luminous objects from ground observations, but the fact is that during the last century astronomers have been amazingly successful, using a combination of techniques for pulling information out of fuzzy images. Because the success of these techniques depends primarily on the distance of the systems from the earth, let us divide them into three separate distance groups. First, there are those nearer than the bright star Vega, in the constellation Lyra, approximately 27 light-years from the earth; second, those farther than Vega and out as far as the Pleiades star cluster, 410 light-years away; and third, those beyond the Pleiades and out as far as the center of our galaxy, 30,000 light-years away.

The sun is just eight light-minutes from the earth, and so Vega lies about the same distance from the sun as from the earth—twenty-seven light-years. Nearer than Vega there are about two hundred known stars, most of which are smaller and dimmer than the sun. Probably many smaller and even dimmer stars remain to be dis-

covered. Only twenty of the nearby stars are visible to the eye without a telescope since fully 90 percent of all nearby stars are very dim dwarfs. Of the twenty brightest nearby stars, we have excellent knowledge because their brightness permits application of all of the techniques at our disposal.

For example, the angular diameter of Vega has been shown by means of interferometry measurement to have a value of 0.0037 arc seconds, about three times that which the sun would have if seen from the same distance. Interferometry is a technique used for the measurement of wavelengths of light in order to determine the distances between stars and the diameters of stars. Interferometry takes advantage of the wave nature of light. That is, light waves from two adjacent points, say, two stars or two points at opposite ends of a star's diameter, will interfere with one another, causing light and dark fringes to appear in the image when an interferometer is properly adjusted. The presence or the absence of fringes as the instrument is adjusted provides a measurement of the diameter of the star or reveals the presence of a companion star. A stellar companion to Vega of similar brightness is easily excluded by such measurements, which also show that Vega has no fainter companions down to approximately one-tenth of its brightness.

The existence of a companion of less than this brightness would be revealed by a perturbation. A perturbation is a wobble in the motion of a star across the sky. Because binary stars revolve in orbits around their common center of mass, a faint companion of one-tenth the mass of Vega would cause Vega to wobble with a motion of one-tenth of the apparent distance between the two stars and with a period the same as their mutual orbital period. Because we can detect wobbles as small as 0.01 arc second by measuring photographs of bright stars taken over the years, a faint companion of one-tenth Vega's mass would be detectable if its distance from Vega were larger than 0.1 arc second. That is equivalent to 0.8 astronomical units at Vega's distance from the earth (one astronomical unit equals the distance between the sun and the earth). If the companion had a mass one-hundredth that of Vega's, its separation would have to be larger than 1.0 arc second, or eight astronomical units, to be detectable, and its orbital period would be about fourteen years. An orbital period longer than this presents an observing problem because at least two orbital periods of observation are needed to confirm the perturbation. For longer periods the companion would at times be outside the fuzzy image of Vega, and direct detection would be possible by visual examination or by photography.

In addition to the wobbling motion caused by a stellar companion, there exists the changing orbital velocity of each member of the pair. The ratio of the velocities of the two members of the binary star, orbiting their common center of mass, will be the inverse of the ratio of their respective masses, with the less massive star having the greater velocity. If the mass of one of the stars is one-tenth that of the other, then the less massive star will have an orbital velocity ten times that of the more massive one. If an astronomer obtains several spectra of

Share the Thrills of Exploring Outer Space!



$359.95 f.o.b. Hartford, Conn.
$15 Crating Charge

Now it's easy to join the thousands of serious amateurs who have discovered the excitement of exploring our mysterious universe. Your enjoyment begins right from the start, yet the challenges and rewards go on for years! And it's a hobby that can be shared at modest cost.

Choose From Many DYNASCOPES®

Picking a telescope to fit your needs and your pocketbook is simple when you select a DYNASCOPE — the same instruments used by more than 150 schools, colleges and observatories — and your satisfaction is guaranteed by a full-refund warranty.

FASCINATING GUIDE YOURS FREE!

Read these valuable facts before buying any telescope. Mail coupon or postcard for your complimentary copy of this helpful guide.



Criterion Manufacturing Co.
620 Oakwood Ave., W Hartford, Conn. 06110

® TM Registered U.S. Pat. Office

CRITERION MANUFACTURING CO., Dept NH 104
620 Oakwood Avenue., W Hartford, Conn 06110
Please send your free Telescope Guide.
Name_____
Address_____
City_____State_____



Enter the world of Questers nature tours.

When you travel with Questers, you have the advantage of our knowledge of the travel world And our experience of the natural world We are travel professionals And our only tour program is Worldwide Nature Tours

Under the leadership of an accompanying naturalist, we search out the plants and animals, birds and flowers rain forests, mountains, and tundra .seashores, lakes, and swamps of the regions we explore At the same time, we include the more usual attractions in touring—the cities, archaeological sites, and people.

The current Directory of Worldwide Nature Tours describes 29 tours varying from 9 to 36 days and going to virtually every part of the world Included are The Amazon, Peru, Patagonia, Galapagos, Hawaii, Alaska, Death Valley, Everglades, Ladakh, Sri Lanka, Iceland, Scotland, Greece, Australia, and New Zealand Tour parties are small, the pace leisurely, and itineraries unusual

Call or write Questers or see your Travel Agent today for your free copy of the Directory of Worldwide Nature Tours.



QUESTERS

Questers Tours & Travel, Inc.
Dept. NH 681, 257 Park Avenue South
New York, N.Y. 10010 • (212) 673-3120



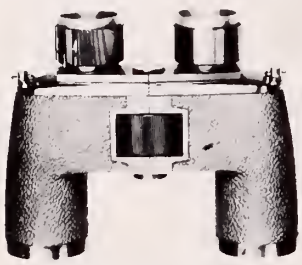
AUDUBON BIRD CALL

Beautifully handcrafted of Birch & Pewter. Just twist & a variety of wild birds answer. The perfect companion for nature lovers of all ages. $5 ea. or 2 for $9 postpaid.

Send check or m o TODAY to Animals & Company BOX 214A, MT. VERNON, NY 10552

BOOKS PUBLISHED

National book publisher can print your book for as little as 18¢ per copy (paperback, 100,000 copies). For further info write: Regal Press Inc., 4555 W. Lovers Lane, Dallas, Texas 75209 or call (214) 353-9913.



BUSHNELL 7x35 CUSTOM

Mfg. List $280.00 Postpaid $164.00

This is an example of the deep discount prices on high quality optics that is found in our FREE catalog. This catalog lists and illustrates an outstanding selection of telescopes, binoculars etc., plus valuable information on how to properly select them. Write for it today.

GIL HEBARD OPTICS
COURTHOUSE SQ., KNOXVILLE, ILL. 61448

WHEN YOU WRITE TO NATURAL HISTORY

about a change of address, renewal of subscription, billing, or any kind of adjustment, send the present address label from the magazine wrapper.

Moving? Please notify 6 weeks in advance. You can use this form to tell us about a move or order a subscription.

Change of address—Attach your address label in the dotted area and fill in your new address below, clip and mail to Natural History Membership Services, P.O. Box 4300, Bergenfield, N.J. 07621.

Cut your old address label from magazine wrapper and attach over this area.
Fill in your NEW address and mail to:
Natural History Magazine
Membership Services P.O. Box 4300
Bergenfield, N.J. 07621

PLEASE PRINT

Name _____

New Address _____

City _____ State _____ Zip _____

the light from such a binary system, shifts in the lines in the spectra may be measurable. These Doppler shifts measure the radial velocity of the brighter of the two stars in the system (a star in a binary pair with, say, one-tenth the mass of its partner will contribute less than one percent of the light of a spectrum). The radial velocity is the component of the star's motion that is directly toward or away from the earth. If we happen to be looking at the system so that the stars are moving at right angles to our line of vision, then their radial velocities will always be zero, and their orbital motions will be undetectable in the spectrum. For most binary systems, the stars are not moving at right angles to our line of vision, however, so that some radial velocity due to orbital motion exists and can be measured if it is large enough and if the star is bright enough so that its spectrum can be obtained with an exposure time that is much less than the orbital period.

In the case of Vega, if a one-tenth mass companion at a distance of 0.8 astronomical units existed, the velocity variation of Vega would be about 3.5 miles per second in five months time. This velocity variation is just detectable, which tells us that in such a case the method is useful for separations of less than 0.1 arc second, because the velocities become larger with decreasing orbital size for any pair of objects. In neither the positional nor the radial velocity observations for Vega itself has a perturbation been detected. Thus, the existence of a companion star with a mass larger than one-tenth that of Vega is virtually excluded by present observations. This does not hold true for all of the other bright stars nearer the earth than Vega, where the techniques of visual examination, interferometry, perturbation measurements, and measurements of radial velocity perturbations have resulted in the detection of numerous stellar companions.

However, most of the nearby stars are not visible to the unaided eye. In fact, the faintest known of these objects are one million times fainter than the brightest 10 percent of the nearby stars. Fortunately, the method of perturbation measurements still works well for these faint stars, although the other methods fail when applied to stars of fainter apparent magnitude. Photographic exposures of up to several hours are required for the faintest stars known, but the positional measurements possible with such photographs are nearly as accurate as those of the very short exposures for stars one million times brighter. Furthermore, the faintest star known, Van Biesbroeck's Star in the constellation Aquila, has a mass approximately one percent that of Vega. A hypothetical companion of Van Biesbroeck's Star would thus produce a wobble of Van Biesbroeck's Star 100 times that produced by a similar companion of Vega. Using the above techniques during the rest of this century, astronomers should find all of the stellar companions of stars nearer than Vega. Most have been found already.

Van Biesbroeck's Star is the least massive star known, with a mass about thirty times that of Jupiter. The theory of stellar interiors indicates that a star with a mass smaller than this will not undergo nuclear burning in its interior, and thus stars of masses from roughly three to thirty times that of Jupiter are termed "black dwarfs." Although they may glow from internal heat as do Jupiter and Saturn (in infrared radiation), they will be much fainter than true stars, such as the sun, which shine as a result of nuclear energy production.

The problem of detecting black dwarfs and planets is not easily solved. When orbiting other stars, planets such as the four giant planets of our solar system—Jupiter, Saturn, Uranus, and Neptune—can be detected by the perturbation method only if the star they are orbiting is one of the nearest to our solar system and if the star has a small mass. However, with existing equipment even these conditions bring the planet only to the fringe of detectability. Fortunately, instrumentation now in the development stage will be capable of greater precision. Also, the launching into orbit of the Space Telescope in 1985 should provide an increase of more than tenfold in our capacity to detect small masses. Thus the opportunity exists to detect some black dwarfs and planets around nearby stars, and perhaps by the year 2000 to at least estimate the number of black dwarfs and planets nearer than Vega.

Let us now look at a more distant region of space, beyond Vega's distance of 27 light-years and extending as far as the Pleiades star cluster, 410 light-years from the earth, or

about fifteen times as distant as Vega. The number of stars out there should increase approximately in proportion to the volume of the region, which is $15 \times 15 \times 15$, or 3,375, times greater than the volume of the region between the earth and Vega. If we multiply $15 \times 15 \times 15$ by 200, for the known stars out as far as Vega, we get 675,000 or more stars that may be nearer than the Pleiades. This region of space, although only a tiny piece of our Milky Way galaxy, is critical to astronomy because in this region many types of stars exist that do not happen to be found nearer to earth than Vega. And in this region, relatively nearby within a 410-light-year radius, astronomers can calibrate the luminosity, or true brightness, of the stars because direct distance determination, which is impossible at greater distances, is feasible. At greater distances the brightness of the stars is generally used to make crude estimates of their distances. This is done by means of the very critical luminosity calibrations in the Pleiades and nearer.

At distances between that of Vega and that of the Pleiades, we can do little to detect black dwarfs and planets because the size of their wobbles decreases in proportion to their distance. The discovery of stellar companions is still possible, however, although more difficult. But the number of stars to investigate for companions is very large, and most of the binary stars known (roughly 50,000) have been discovered in this region by direct visual examination of the image through the telescope. An experienced visual observer can detect stars separated by only one-tenth of an arc second by waiting patiently for moments of excellent viewing. Superb eyesight and telescope quality are required for this demanding task, as well as unusual endurance on long, cold nights.

Radial velocity perturbations do not decrease with distance, and therefore, for sufficiently luminous stars, the method of velocity perturbations retains its value out to great distances. However, the brightness of a star decreases with the square of its distance. If Vega were moved fifteen times farther away, to the distance of the Pleiades, it would be 15×15, or 225, times fainter, and the exposure required to obtain its spectrum would be 225 times longer, or roughly an hour. In principle, we have the capacity to discover in this region all companions that are of a luminosity brighter than that of our sun. In practice, there are too many such objects, and we must be somewhat selective.

Beyond the distance of the Pleiades lies 99.99 percent of our galaxy and roughly 100 billion other galaxies. All of the universe must be interpreted in terms of what is observed in the Pleiades and nearer because of the blurred images and faintness that limit most observations beyond the Pleiades. The number of stars becomes huge, in the hundreds of billions within our galaxy alone. In such an enormous sample of stars, another detection technique becomes possible. Many binary star systems will be found oriented in such a way that their orbital plane lies nearly exactly in the line of sight. The two stars of a binary system will pass in front of each other producing eclipses at intervals of one-half of their orbital period. The brightness variation makes such "eclipsing binaries" show up on repeated photographs. Once the brightness changes of an eclipsing binary system are detected, detailed study can yield a rough idea of the shapes and surfaces of both stars. If the stars are bright and their radial velocities are obtainable, astronomers can measure with precision the diameters of the stars in the pair by determining the lengths of the two eclipses in the orbital period. Thus even at distances of thousands of light-years, for a few select stars we can measure sizes down to one-millionth of the image diameter and, in a fashion, see two stars.

In our solar system a similar technique will yield a special surprise in the case of the planet Pluto and its moon Charon. A few years from now, Pluto's slow orbital motion around the sun will line up its orbital plane and that of Charon in such a fashion that seen from the earth each object will alternately eclipse the other. For some five subsequent years this system will behave like an eclipsing binary, with an orbital period of about six days. Thus a brightness mapping of the surfaces of both bodies will be obtainable, and we will at last be able to discern the details of Pluto and Charon despite their distance from the earth.

James W. Christy is an astronomer at the U.S. Naval Observatory in Washington, D.C. He is credited with discovering Pluto's satellite Charon in 1978.

Presenting the Arctic

Magnificent. Dramatically different. Seen by few.

A land of delicate wildflowers and vast rolling tundra. The home of caribou, polar bear, sea mammals, migratory birds, Arctic char. And the land of the midnight sun.



Meet and visit the Inuit ...great hunters, skilled craftsmen, a people in harmony with this land.

For more information on tours into the western Hudson Bay region of Canada's Arctic write to:

Keewatin Chamber of Commerce
Rankin Inlet, Northwest Territories
Canada X0C 0G0

NATURAL HISTORY MAGAZINE BINDER

The functional way to save your full year's issues for future reference and pleasure "Natural History" stamped in gold color on dark green leatherette over heavy binder's board. 12¾" x 9". Price $6.50. Members $5.85



American Museum of Natural History
Museum Shop
Dept. 229
C.P.W. at 79th St.
N.Y., N.Y. 10024

Qty	Price	Shipping Handling	Total
		$2.00 ea.	
		Order Total	
		N.Y. Sales Tax	
		Total Amount	

Enclosed is check / money order for $ _____

Name _____

Address _____

City _____ State _____ Zip _____

Like your solid comfort? A versatile Questar rests on a table while you sit comfortably in your chair to observe the skies or the wildlife around you. The same sharp resolution that astronomers enjoy when they turn their Questars on the moon and planets will show you enchanting detail of birds that are beyond the reach of binoculars or inferior telescopes. It's a whole new world with a Questar.
Send for our booklet in color on Questar, the world's finest, most versatile telescope; photos by Questar owners. $2, please, to cover mailing costs.

THERE'S NOTHING LIKE A QUESTAR



QUESTAR
Box TNH, New Hope, Pa. 18938 (215) 862-5277

Better Than Jogging



NordicTrack
Jarless Total Body Cardiovascular Exerciser Duplicates X-C Skiing for the Best Motion in Fitness

This revolutionary new exerciser duplicates the smooth, rhythmic, total body motion of X-C skiing for the most effective cardiovascular exercise obtainable. Uniformly exercises more muscles than any other exercise device. Makes high heart rates easy to obtain and keeps more muscles in tone. Also highly effective for weight reduction.

Completely jarless natural motion does not cause joint and back problems as in jogging or running. Arm and leg resistances are separately adjustable for maximum effectiveness. The NordicTrack uses no motors and folds compactly for convenience. Used in homes, businesses, and institutions. Our customers include Xerox Corporation, US Army, Penn State U and the YMCA.
For more info, call or write
PSI 124 L Columbia ct. Chaska, MN 55318
toll free 1-800-328-5888, MN. 612-448-6987

Celestial Events

by Thomas D. Nicholson

The Moon Phases in June are new on the 2nd, first-quarter on the 9th, full on the 17th, and last-quarter on the 24th. The next new moon is on July 1, first-quarter on July 8, and full on July 16.

The early crescent moon should appear by the 4th or 5th below the twin stars of Gemini, Castor and Pollux. By the evening of the 7th, the moon is entering Leo, and the bright star near it is Regulus. The first-quarter moon of June 9 is entering Virgo. The bright objects near it on the 9th and 10th are Jupiter and Saturn and on the 11th, Spica, Virgo's brightest star. The waxing gibbous moon passes above Antares, the bright red star of Scorpius, on June 15. Full moon of June 17 is very close to the winter solstice, in Sagittarius, and the waning gibbous moon moves through Capricornus on June 20 and 21.

The first glimpse of the crescent moon in July should be on the 5th, with Regulus nearby. Entering Virgo on July 7, the moon passes near Jupiter and Saturn that night and is near Spica on the 8th. The full moon of July 16 is in Sagittarius again, and a partial lunar eclipse (visible in North America) occurs July 16–17.

Stars and Planets At one time or another in June, all the planets but Mars are evening stars (Mercury is one until the 21st and Neptune after the 14th), but only Jupiter and Saturn are bright enough and sufficiently well placed for viewing. Uranus, Neptune, and Pluto are too dim to be seen and Mercury, Venus, and even Mars, although it is a morning star, are too close to the sun's position.

Jupiter and Saturn are very well placed, however, high in the south–southwest at dusk. In their position near the western edge of Virgo, they have no competition from nearby bright stars. They stand out because of Jupiter's brilliance (once Venus sets, Jupiter is the brightest object visible, except for the moon) and because of Saturn's proximity to the brighter planet. During the early evening, they move west together, trailed by Spica, the brightest star of Virgo. Be sure to look on the nights of June 9, 10, and 11 when the moon is passing through their part of the sky.

Jupiter and Saturn (after the 5th) have resumed direct, easterly motion through the stars and both will move slowly closer to Spica, while Jupiter in turn moves closer to Saturn. Jupiter, the brighter of the two, is to the right all month, but the distance between them diminishes markedly, and Jupiter will slide slowly to Saturn's south (below it). In late July, Jupiter will pass to the left (east) of Saturn, the third and last of the three conjunctions that have occurred since January 14.

Venus and Mercury may be glimpsed as evening stars early in June, low in the west during twilight. Venus, which is very bright, will be the easier to see and viewing it improves during the month. Mercury will be better placed at the beginning of June, but it is not very bright and moves closer to the sun rather quickly.

Mars, the only visible planet in the morning, rises just before dawn, north of the Hyades in Taurus. However, it is a dim, inconspicuous object and will remain so for many months.

The sun spends most of June in the constellation Taurus, moving into Gemini just before reaching the summer solstice. Mercury is in Gemini all month until it moves westerly into Taurus for a brief period in late June and early July. Venus moves out of Taurus into Gemini in early June and into Cancer before the end of the month. Mars is in Taurus all month, Jupiter and Saturn are in Virgo near the autumnal equinox, Uranus is in Libra (close to Scorpius), Neptune is in Ophiuchus (near Sagittarius and the position of Kepler's Nova of 1604), and Pluto is in the southwest corner of Boötes, near Virgo.

June 1–2: Perigee moon (nearest the earth) occurs 21 hours before the new moon, adding its force to the usu-

ally stronger spring tides. Look for higher tides on the 2nd.

June 3: If the western sky is clear enough, you might see the very slender crescent moon (only 36 hours old) to the left and above Venus. Mercury is closer to the moon, to its right.

June 5: Saturn is stationary, relative to the stars, and resumes its normal direct (easterly) motion.

June 9: Mercury begins its retrograde (westerly) motion, rapidly approaching the sun's position as it moves between the earth and the sun.

June 9–11: Be sure to watch the moon move past Jupiter and Saturn (from the 9th to the 10th), and then past Spica (on the 11th).

June 13: The moon is at apogee (farthest from the earth).

June 21: The sun arrives at the summer solstice at 6:45 A.M., EST, and summer begins in the Northern Hemisphere. The sun's path across the sky today is the highest and longest of the year, making the 21st the longest day. However, as sunrise–sunset tables will verify, this is *not* the date of the earliest sunrise and latest sunset. Earliest sunrise occurs about June 14 and latest sunset about June 27, but the dates vary with latitude.

June 24–25: The last-quarter moon rises about midnight on the 24th. If you are curious about the position of the vernal equinox, it is just above the moon's position in tonight's sky.

June 29–30: Another perigee moon occurs on the 29th. The star nearest the crescent moon at dawn is Mars.

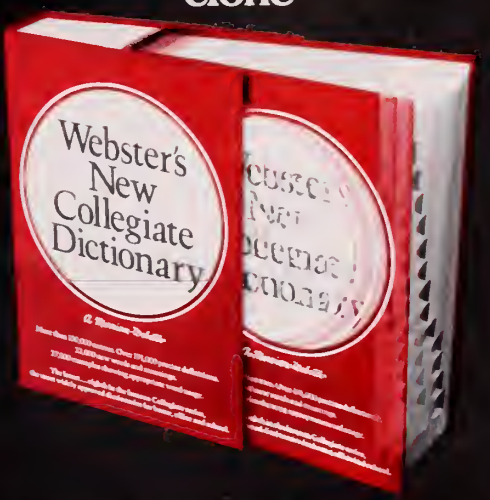
July 3: Mercury resumes direct (easterly) motion. The earth is farthest from the sun (aphelion), 152,103,000 kilometers (94,513,000 miles) distant.

July 7–8: The moon again passes Jupiter and Saturn (on the 7th) and Spica (on the 8th).

July 14: Mercury is at greatest elongation from the sun in the morning sky, but not well placed for viewing.

July 16–17: A partial lunar eclipse occurs tonight, visible in North America from 10:25 P.M. until 1:10 A.M., EST. (Adjust for other time zones.)

clone



Webster's New Collegiate Dictionary.
It's where the words live.

America's best-selling dictionary doesn't just define words. It brings them alive. Over 150,000 of them, old and new. Full of quotations, usage examples and illustrations, it gives you a new kinship with "clone," lets you cut through the mystery of "laser." It's a whole new meaning for "dictionary." Just $12.95. A great gift. Merriam-Webster Dictionaries, Springfield, MA 01101.

FROM MERRIAM-WEBSTER®

c G&C MERRIAM 1978



Seven
beautiful ways
to keep warm

At last — a superbly efficient woodburning stove beautiful enough for your home. And now in your choice of seven decorator tile colors!

The WESO Ceramic Tile Stove employs both convection and radiant heat to surround you with gentle, all-over warmth. The fire burns all night without tending — and when the coals have finally died, the tiles continue releasing heat into your rooms.

The WESO is built to burn both wood or coal. As you will see in our color literature, in appearance it is nothing less than breathtaking.

All WESO stoves have been tested to UL standard 1482

Plus
a new coal-
burning stove



A handsome enamelled cast iron heater from WESO. Burns cleanly and odor-free up to 24 hours on a loading

Why settle for any stove that offers any less than these 10 important features?

1. Tiles are safer to touch than blistering metal. 2. Liquid expansion thermostat for precise heat control. 3. Firedoor window lets you view the flames 4. Suspended burning basket and shaker grate permit burning coal safely 5. Air-tight construction for long fire life 6. Ash pan for mess-free cleaning 7 Top grille lifts for cooking 8. All-night burn 9. Secondary air combustion system 10. Protective wrought-iron style front grille swings away at a touch.

Rush me your literature portfolio by first class mail, featuring the WESO in all seven tile colors, complete performance data, details on WESO's new coal stove, and current shipping schedule. Enclosed is $1 to help cover mailing costs.

Name _____

Address _____

_____ Zip _____

Ceramic Radiant Heat
2916 Pleasant Dr., Lochmere, N.H. 03252
Call 603/524-9663

The Wildest of All Wild Places

by Boyce Rensberger

SAND RIVERS, by Peter Matthiessen. *The Viking Press, $19.95; 213 pp., illus.*

The "real Africa" has probably always been more a state of mind than a place. If you grew up in America or Europe, the very word itself, spoken in awe—Africa—was enough to evoke images of a deep and mysterious continent, the wildest of all wild places. Whether the images were nurtured by Joseph Conrad or Ernest Hemingway or even Edgar Rice Burroughs, Africa was the farthest you could go from where you were. Africa was one of those places you hoped would always be there.

If you grew up in Africa, as did Brian Nicholson, a crusty old game warden who is the central figure in Peter Matthiessen's new book, *your* real Africa also lives in the mind. Not as a vicarious image but as a memory of the untrammeled natural spectacle that existed before Westernization pushed so far. It is the selective memory of one's youth mixed with the suspicion that things really were better in the old days. Your real Africa isn't there anymore.

Sand Rivers is the true story of a quest to recapture one piece of the real Africa, the little-known Selous Game Reserve in southern Tanzania. The Selous (pronounced Se-loo) is considered by some to be the greatest stronghold of large wild animals left on the earth. The book is a vivid and at times poetic diary of a foot safari, complete with ten barefoot porters, into a region where few have trod since the slavers and ivory caravans withdrew a century ago. The few Africans who lived there were evicted decades ago when colonial administrators established the reserve, and even then tsetse flies were keeping human numbers low.

Matthiessen's expedition—his first literary return to Africa since *The Tree Where Man Was Born*—took place in late 1979. As roads and Land-Rovers swarm over practically every other part of East Africa, Matthiessen and Nicholson walk into the unmapped wilderness. They take no compass but follow an old African game tracker named Goa, who probes the tall grass and miombo woodland with a drooping hand stretched ahead like a five-fingered dowsing rod. His yellowed eyes spot the dark elephant shadows moving in the distance, the lions prowling nearby, the startled rhino mother prepared to defend her calf. Bloody close calls in the past have taught Nicholson to carry a .458 "elephant gun," but Goa, wise in animal ways, always leads the silent file around the edge of the beast's perceived zone of safety.

Some 100,000 elephants have been estimated to live in the Selous, more than in all the rest of East Africa. There are also about 650,000 other large animals, including East Africa's largest populations of rhino, buffalo, hippo, crocodile, lion, and leopard, along with 350 species of birds and some 2,000 kinds of vascular plants.

Although the Selous Game Reserve has had some form of official protection for more than sixty years, it has been too remote from airports and tourist circuits to enjoy the fame or suffer the pressures of the kind experienced by the Serengeti National Park, some 400 miles to the northwest, or by Kenya's Amboseli, Tsavo, or Maasai Mara national parks. The Selous's only "use" has been as a reserve for very strictly limited sport hunting, an activity that threatened no species but did, until it was banned in 1973, bring Tanzania appreciable revenues.

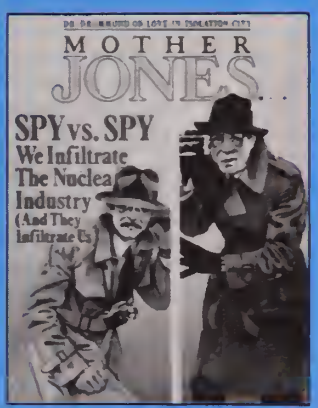
The largest wildlife sanctuary in Africa, the Selous's 22,000 square miles make it three times the size of the vast Tsavo National Park and nearly four times as big as the Serengeti. Unlike most other wildlife sanctuaries, it is well watered by a network of broad, sand-lined rivers. Unlike other African reserves, the Selous covers an entire ecological unit, three of them in fact. This means that all the watersheds and migratory routes essential to its ecosystems lie within its boundaries.

And yet, as Matthiessen frequently intimates but never fully establishes, there are disturbing signs that the end may be near or, at least, the beginning of the end.

Before he quit in disgust in 1973 to become a charter pilot in Nairobi, Brian Nicholson had been in the Selous for twenty-three years, most of them as a game department warden. With the staff of crack game scouts that he trained, Nicholson watched carefully over the sanctuary he loved, battling poachers, working to expand the boundaries, and periodically burning the dry grasslands to—at least as he saw it—encourage the new growth that would continue to attract and hold the vast herds.

The Selous region had been made a game reserve as early as 1905 when the Germans were there. After World War I, when Tanganyika Territory, as it was called, passed into British hands, the reserve was maintained. In 1922, it was formally named after Frederick Courtenay Selous, a legendary British elephant hunter and explorer who once served as Theodore Roosevelt's "white hunter." In the 1930s a colorful young game ranger named C.J.P. Ionides came to the region and, with Selous as his hero, privately made it his life's work to protect and enlarge the reserve. With determination and, at times brutality, Ionides forced Africans out of the area

Meet Mother Jones.



The first issue is free.

Send me a free copy of **Mother Jones**. If I like it, I will pay you $12 (33% savings off the regular subscription price) for a full year—nine more issues. If I decide not to subscribe for any reason, I'll just mark "cancel" on the bill and that's it—no further obligation.

☐ Payment enclosed ☐ Bill me later

Name _____

Address _____

City _____

State _____ Zip _____

ADD $2 per year Canada; $4 per year foreign

DFNHBF

NO POSTAGE
NECESSARY IF
MAILED IN THE
UNITED STATES

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO. 671 MARION, OH

POSTAGE WILL BE PAID BY ADDRESSEE

MOTHER
JONES
1886 HAYMARKET SQUARE
MARION, OHIO 43306

MOTHER JONES
MAKES NEW WAVES.

Our investigations have uncovered the dumping of hazardous products on foreign markets, a dangerous IUD, the deadly Pinto, Nestle's disastrous marketing of infant formula, and other scandals. MOTHER JONES gets results: legislation, recalls, and compensation for victims. We set a record for winning National Magazine Awards—three in our first four years of publishing. (That's the Pulitzer Prize of the magazine industry.)

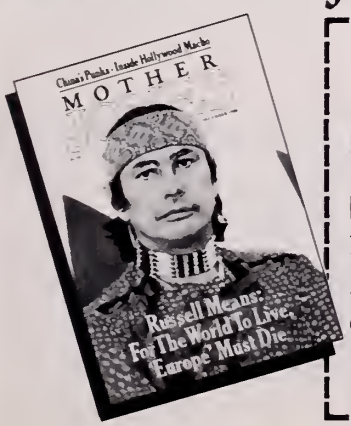
MOTHER JONES
MAKES ENEMIES.

Some of the fattest cats in America have demanded everything from the revocation of our National Magazine Awards to denial of our mailing rights. We get under their skin—and they yell. We've been called "irresponsible, scabrous" (by an Agency for International Development official), a publisher of "lies, half-truths and distortions" (by a top Ford executive, about our article which made him recall two million Pintos), and "sleazy" (by Ronald Reagan's chief foreign policy advisor). We've never been called "dull."

MOTHER JONES
MAKES SENSE.

Whether our writers are taking on corporations, doctors, or Hollywood, you can expect MOTHER JONES to hit the target. Hard. Look at some recent stories: "Eating Our Hearts Out," on the politics of fat; "Running in Reverse," the report on a Ford transmission blunder which proved so severe that ten people died in the five months we were working on the story; "Filthy Lucre," the inside view of America's porn industry; "The Bendectin Cover-Up," a special investigation into the shocking history and government approval of a dangerous drug which has been taken by more than 30 million women. MOTHER JONES gives you special reports on up-to-the-minute topics like: medical malpractice and the alarming rise in Caesarean sections; the nuclear arms build-up and our race for extinction; the coming civil war in South Africa and the uneasy death of apartheid; the controversy raging over sex, violence and the meaning of pornography.

MOTHER JONES MAKES YOU AN OFFER.



I CAN'T REFUSE!

Send me a free copy of **Mother Jones**. If I like it, I will pay you $12 (33% off the regular subscription price) for a full year—nine more issues.

☐ Payment enclosed ☐ Bill me later

Name _____

Address _____

City _____ State _____ Zip _____

DFNHPF

ADD $2 per year Canada; $4 per year foreign

MOTHER JONES Subscription Department, 1886 Haymarket Square, Marion, OH 43305

GUARANTEE: If you're ever dissatisfied *for any reason*, tell us and we'll refund your subscription for any and all unmailed copies. That's how sure we are that you'll like MOTHER JONES.

Sri Lanka's
PERAHERA
Festival of the August Moon

Join a special tour to Asia's most spectacular celebration honoring the Sacred Tooth Relic of the Buddha. A hundred elephants, dancers, drummers, temple bells, the cracking of whips, blazing torches that light a myriad gems create the stunning pageantry of the Kandy Perahera.

You also tour the countryside to see ancient cities in the interior, the hill country, coastal villages, spice gardens, tea estates and craft centers. Extensions to the mountain valley of Kashmir and to the temple cities of South India are available.

For information please contact:

JOURNEYWORLD INT'L LTD.
155 EAST 55th ST NEW YORK N Y 10022
TEL (212) 752-8308


HANDCARVED SERVERS
Five different animal designs crown these exotic African hardwood servers Perfect for the salad bowl A unique gift! Why not have several pairs handy?
GIRAFFES / LIONS / RHINOS
ELEPHANTS / ANTELOPES
6" size $5 pr. / 12" size $8 pr postpaid
Circle choices & send check or m o TODAY to
Animals & Company
BOX 214A MT VERNON NY 10552

EXPLORE DARWIN'S
GALAPAGOS

THE BUCCANEER
"Largest Galapagos ship"
Cruises from $578 Plus Air Fare
All outside Air conditioned Staterooms, Private baths Includes all meals aboard. Shore excursions conducted by multi-lingual naturalist guides
Also visit MACHU PICCHU,
THE AMAZON, QUITO, LIMA, CUZCO,
IQUITOS on new low air fare
Write for brochures, deck plans, tariffs, itinerary
GALAPAGOS, Inc.
Suite 112-C, 7800 Red Road So Miami FL 33143
Name _____
Address _____
City/State/Zip _____



and persuaded the colonial government to enlarge the reserve.

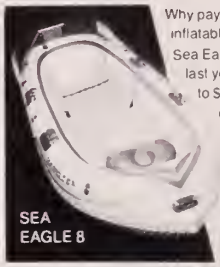
Ionides left the Selous Game Reserve in 1954 to become a collector of rare animals, but Nicholson was there to carry on the tradition. In the early 1970s, however, the Tanzania Game Department was "Africanized," and many of the former colonial officials who had stayed on out of a dedication to wildlife were replaced with African civil servants who had little interest in the reserve. Funding and official support dwindled, and Nicholson found it impossible to maintain antipoaching patrols or to ward off economic and agricultural development programs that he felt threatened the sanctuary. One, for example, was a huge dam that is still under construction by the Norwegians in the eastern part of the Selous. Although the reservoir itself, planned for completion in about 1990, will do little harm, it is expected to create a whole fishing industry that will encourage new settlements. A new road linking the dam with distant towns is likely to "open up" the region to unprecedented agricultural development.

The colorful stories of Frederick Courtenay Selous, C.J.P. Ionides, and Brian Nicholson emerge in *Sand Rivers* as recollections and flashbacks illuminating the book's main narrative, the foot safari. In a way the safari was a publicity stunt dreamed up by Tom Arnold, a British M.P. who had recently become enchanted with Africa and who felt an international effort was needed to protect the Selous. It was his idea to have Matthiessen accompany Nicholson, the man who knew the Selous best, for a close inspection of the reserve in the most exciting way to see Africa—on foot. Matthiessen would do a book and Hugo van Lawick, the wildlife photographer, would go along to make pictures. The result is an undeniably persuasive combination.

Many who have never before heard of the Selous will probably finish the book eager to rally to the battle against poachers and rapacious development. But, worthy as the words and pictures are, *Sand Rivers* does not really make a very strong case that the Selous Game Reserve is truly in grave danger. Aside from the dam, most of the evidence is circumstantial or intuitive.

Many times, for example, Nicholson visits a part of the Selous where he had once seen great herds of elephant or buffalo and, this time, sees

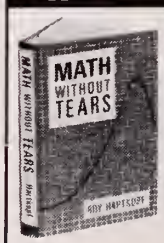
AUTHORS WANTED BY
NEW YORK PUBLISHER
Leading subsidy book publisher seeks manuscripts of all types: fiction, non-fiction, poetry, scholarly and juvenile works, etc. New authors welcomed. Send for free, illustrated 40-page brochure W-82 Vantage Press, 516 W. 34 St., New York, N.Y. 10001

SEA EAGLE
The Quality Alternative
to High-Cost Inflatables


Why pay $600 or more for an inflatable boat?
Sea Eagles pack small, last years and cost $100 to $220 Canoes, dinghies and motormount boats
Write for **FREE** brochure
Sea Eagle
Dept NH6
St James, NY 11780
phone 516 724 8900

PERU
CUSCO — MACHU PICCHU
THE AMAZON
The largest variety of tour packages including First Class and Delux hotels, at the lowest price ever.
CALL NOW—TOLL FREE 1-800-223-1367
IN N.Y. CALL COLLECT (212) 582-7811
VALISHA TRAVEL
250 W. 57th. St.
N.Y.C. 10019

BOOK HUNTING?
Virtually any book located—no matter how old or long out-of-print. Fiction, nonfiction. All authors, subjects. Name the book—we'll find it! (Title alone is sufficient.) Inquire, please. Write: Dept. 71
BOOKS-ON-FILE P.O. BOX 195
UNION CITY, NEW JERSEY 07087

MATH WITHOUT TEARS


Using non-technical language and a light touch Roy Hartkopf gives you a basic understanding of many everyday applications of mathematics. He takes the reader from simple counting to trigonometry and calculus, emphasizing the practical aspects of math. Humorously written.
Learn math in the comfort of your own home at minimum cost.
Order Now: $9.95 plus $1.10 hdlg.
EMERSON BOOKS, INC.
Dept 749-F Buchanan, N Y
10511
10 Day Money Back Guarantee

few or none. Matthiessen and Nicholson do come across some bones of killed elephants but they find nothing on the scale of poaching seen in Kenya in recent years. Nevertheless, Nicholson concludes that poachers must have decimated the herds. Matthiessen, on the other hand, observes that elephants are known to desert an area for their own reasons and to stay away for years. Although the hard evidence of truly major damage to wildlife is lacking, Matthiessen allows his eloquence to serve the more pessimistic view.

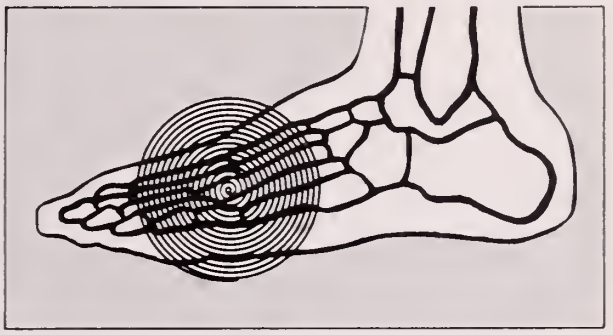
"We gazed about us for a little while at the vast wilderness all around," he writes of a visit to the reserve's Nandanga Mountain. "No sign of man, no marks or sounds, for hundreds of square miles. Even the ring-necked doves had fallen silent. There is a silence in the imminence of animals and also in the echo of their noise, but the dread silence is the one that rises from a wilderness from which all the wild animals have gone. In the dead still afternoon of the old continent, it seemed to me that the silence of Nandanga still had an imminence, a listening, a waiting in the air."

It is a cryptic remark, deliberately left cryptic, just as Matthiessen leaves many other thoughts in a state of ambivalence and observations open to several interpretations. Africa is like that.

Tanzania is one of the world's poorest countries and unquestionably must concentrate its resources on its own economic development. Building a dam in the Selous may even be the right thing for Tanzania to do. But the Selous is every acre the glorious wildlife spectacle that Matthiessen and van Lawick show it to be. And it is one of the last great wildernesses on earth. Compromises with economic development may destroy the real Africa in the minds of people like Brian Nicholson, but if *Sand Rivers* can rally enough international support for the Selous before it really is too late, it will have served not only Tanzania. It will have assured all the rest of us that our real Africa will always be there.

Boyce Rensberger, a science writer who lived in East Africa in 1973 and 1974, recently joined Science 81 *as a senior editor. His book,* The Cult of the Wild, *a study of attitudes toward wildlife conservation, was published in 1977.*

My Feet Were Killing Me...Until I Found Relief in Germany!



It was the European trip I had always dreamed about. I had the time and money to go where I wanted — see what I wanted. But I soon learned that money and time don't mean much when your feet hurt too much to walk. After a few days of sightseeing my feet were killing me.

Oh, I tried to keep going. In Paris I limped through Notre Dame and along the Champs-Elysées. And I went up in the Eiffel Tower although I can't honestly say I remember the view. My feet were so tired and sore my whole body ached. While everybody else was having a great time. I was in my hotel room. I didn't even feel like sitting in a sidewalk cafe.

The whole trip was like that until I got to Hamburg, Germany. There, by accident, I happened to hear about an *exciting breakthrough for anyone who suffers from sore, aching feet and legs.*

This wonderful invention was a custom-made foot support called Flexible Featherspring. When I got a pair and slipped them into my shoes *my pain disappeared almost instantly.* The flexible shock absorbing support they gave my feet was like cradling them on a cushion of air. I could walk, stand even run. The relief was truly a miracle.

And just one pair was all I needed. I learned that women also can wear them — even with sandals and open backed shoes. They're completely invisible.

Imagine how dumbfounded I was to discover that these miraculous devices were sold only in Europe. Right then I determined that I would share the miracle I discovered in Germany with my own countrymen.

In the last nine years over a quarter million Americans of all ages—many with foot problems far more severe than mine—have experienced this blessed relief for themselves.

Here's why Featherspring work for them and *why they can work for you.* These supports are like nothing you've ever seen before. They are custom formed and made for *your feet alone!* Unlike conventional devices, they actually imitate the youthful elastic support that Nature originally intended your feet to have.

Whatever your problem—corns, calluses, pain in the balls of your feet, burning nerve ends, painful ankles, old injuries, backaches or just generally sore, aching feet. Flexible Featherspring will bring you relief with every step you take or your money back.

Don't suffer pain and discomfort needlessly. If your feet hurt, the miracle of Germany can help you. Write for more detailed information. There is no obligation whatsoever. Just fill out the coupon below and mail it today. No salesman will call.

WHAT PEOPLE SAY ABOUT THE MIRACLE:

"Received my wife's Featherspring two days ago. They are super—neither of us can believe the results. She has had terrible feet for years; already no pain. Incidentally, her sore knee is much better . . . As a retired physician, this result is amazing." Dr. C.O.C. Tucson, Arizona.

"My husband felt a great relief and no more pain. They are truly an answer to our prayers. Only wish that he had heard of them twenty years ago." Mrs. F.S./Metairie, Louisiana.

"I have checked your corporation with (A Consumer Protection Agency), and received an excellent report." H.S.H./Louisville, Kentucky.

© 1981 Featherspring International Corp
13100 Stone Avenue, North Seattle Washington 98133

FEATHERSPRING INTERNATIONAL CORPORATION
13100 Stone Avenue, North Dept. NH061
Seattle, Washington 98133

YES! I want to learn more about the relief Flexible Featherspring Foot Supports can give. Please send me your free brochure. I understand that there is no obligation and that no salesman will call.

Print Name

Address

City

State Zip

When in Seattle visit the Featherspring building

Carbon Forests (p. 32)

For a discussion of how excess atmospheric CO_2 may cause major climatic changes, see W.S. Broecker's "The Hazards of Coal Dependence" (*Natural History*, October 1977, pp. 8–19). In "The Biota and the World Carbon Budget" (*Science*, vol. 199, pp. 141–45), G.M. Woodwell et al. review the role of the terrestrial biota in the world carbon budget and conclude that the biota is not a sink for CO_2 but may be a source as large as, or larger than, the fossil-fuel source. Detailed methodology for reconstructing land-use history and changes in biomass and carbon is included in "Carbon Budget of the Southeastern U.S. Biota: Analysis of Historical Change in Trend from Source to Sink," by H.R. Delcourt and W.F. Harris (*Science*, vol. 210, pp. 321–23). "Fate of Fossil Fuel Carbon Dioxide and the Global Carbon Budget," by W.S. Broecker et al. (*Science*, vol. 206, pp. 409–18), evaluates various assumptions and models used to estimate the global carbon budget for the last twenty years and states that there is no compelling evidence establishing that the terrestrial biomass has decreased at a rate comparable to that of fossil-fuel combustion over the last two decades. G.M. Woodwell's "The Carbon Dioxide Question" (*Scientific American*, January 1978, pp. 34–43) examines the upward trend of CO_2 in the atmosphere caused by fossil-fuel combustion and forest destruction and speculates whether forests and oceans can store enough carbon to avert a major change in world climate. R. Allen's "The Impact of CO_2 on World Carbon" (*Environment*, December 1980, p. 6) warns that if present trends continue, a doubling of atmospheric carbon could occur sometime in the middle of the next century, raising average world temperature and initiating rapid, traumatic physical and biological changes.



Mississippi sawmill, 1893

Mississippi Department of Archives and History

Hausa Children (p. 44)

The daughter of a Hausa farmer and an Arabic teacher, Baba, a Muslim Hausa woman, agreed to dictate her autobiography to her friend M.F. Smith, wife of a social anthropologist studying in Nigeria. Baba's recollections, from the days before the British occupation up to the late 1940s, are recorded in *Baba of Karo* (London: Faber and Faber, 1954). N. Skinner's *Hausa Tales and Traditions* (London: Frank Cass and Co., 1969), the first of a three-volume compilation of Hausa folklore, history, and miscellania, is devoted to folklore. Comparing the religious and political sectors in Kano and tracing attitudes toward authority and community, J.N. Paden's *Religion and Political Culture in Kano* (Berkeley: University of California Press, 1973) argues that Kano's political culture has been deeply influenced by religious values and structure. W. Adamu provides a general summation of Hausa history in *The Hausa Factor in West African History* (Zaria: Ahmadu Bello University Press and Oxford University Press, 1978). P. Hill delineates the socioeconomic framework of a small Hausa village in *Rural Hausa* (Cambridge: Cambridge University Press, 1972). In the more recent *Population, Prosperity and Poverty* (Cambridge: Cambridge University Press, 1977), in a sense a companion volume to *Rural Hausa*, Hill reports on her fieldwork in an exceedingly densely populated locality of rural Hausaland, Dorayu, contrasting this area with the much less populated village of her previous study. Both books contain historical information and descriptions of Hausa life style. An analysis of how sex and age affect work, property rights, power, and order in different ethnographic contexts, *Sex and Age as Principles of Social Differentiation*, edited by J.S. La Fontaine (New York: Academic Press, 1979), includes E. Schildkrout's "Age and Gender in Hausa Society: Socio-Economic Roles of Children in Urban Kano" (pp. 109–

37). Schildkrout also interprets work roles in "Women's Work and Children's Work: Variation among Moslems in Kano," in *Social Anthropology of Work*, edited by S. Wallman (New York: Academic Press, 1979, pp. 69–85). Although it does not cover Hausa women, *Women in the Muslim World*, edited by L. Beck and N. Keddie (Cambridge: Harvard University Press, 1978), is useful for comparative purposes.

Shakespeare (p. 54)

S. Schoenbaum's article in this issue is adapted from his *Shakespeare: The Globe & the World* (New York: Folger Shakespeare Library and Oxford University Press, 1979), published as a catalog for a touring exhibition of the same name. Illustrated with rare materials from the Folger Shakespeare Library, the book's subjects range from the fauna and flora of Warwickshire to Shakespeare's years in Stratford and London. A. Gurr's *The Shakespearean Stage, 1574–1642* (Cambridge: Cambridge University Press, 1970) pictures Shakespearean society, drama, acting companies, theaters, and staging. For background on the Elizabethan era, see *The Horizon Book of the Elizabethan World*, by L.B. Smith (New York: American Heritage Publishing Co., 1967), a large, colorful book featuring a picture portfolio of the Elizabethan theater, and A.L. Rowse's more scholarly treatment, *The England of Elizabeth* (New York: Collier Books, 1966), an encyclopedic survey of that society's socioeconomic, political, and cultural structure. Rowse's *William Shakespeare* (New York: Harper and Row, 1963) and S. Schoenbaum's *William Shakespeare: A Compact Documentary Life* (New York: Oxford University Press, 1978) are two carefully researched biographies. Because of their age, some of the better books on Shakespeare and natural history are generally not available except to those with access to large or university libraries. Among these are E.S. Rohde's *Shakespeare's Wild Flowers: Fairy Lore, Gardens, Herbs, Gatherers of Simples and Bee Lore* (London: The Medici Society, 1935), a "poetical and historical" work that analyzes Shakespeare's references to natural history and features color plates of beautiful, rare watercolors; and *The Animal-Lore of Shakespeare's Time* (London: K. Paul, Trench and Co., 1883), which, according to author E. Phipson, brings together "in an accessible form waifs and strays of information, collected from various sources, relating to medieval natural history. . . ." *The Birds of Shakespeare* (Chicago: University of Chicago Press, 1965) is a reprint of J.E. Harting's *The Ornithology of Shakespeare Critically Examined, Explained, and Illustrated*, an 1871 work that addresses Shakespeare's general knowledge of ornithology and natural history. *Shakespeare's London*, by H.T. Stephenson (New York: Henry Holt and Co., 1905), primarily an outline of the city "as it was seen by Shakespeare," describes the customs, theaters, taverns, main highways, the Tower of London, and the waterfront.

Collared Peccaries (p. 60)

For general, nontechnical information on collared peccaries, see the section on hogs, pigs, and peccaries in E.P. Walker's *Mammals of the World*, vol. 2, pp. 1357–66 (Baltimore: The Johns Hopkins University Press, 1975), and H. Frädrich's article on swines and peccaries in *Grzimek's Animal Life Encyclopedia*, vol. 13, pp. 76–108. *The Journal of Wildlife Management* has published a number of articles on collared peccaries; among the most notable are T.A. Eddy's "Foods and Feeding Patterns of the Collared Peccary in Southern Arizona" (vol. 25, pp. 248–57); J.E. Ellisor and W.F. Harwell's "Mobility and Home Range of Collared Peccary in Southern Texas" (vol. 33, pp. 425–27); and R.E. Schweinsburg's "Home Range, Movements, and Herd Integrity of the Collared Peccary" (vol. 35, pp. 455–60). S.W. Herring's "The Role of Canine Morphology in the Evolutionary Divergence of Pigs and Peccaries" (*Journal of Mammalogy*, vol. 53, pp. 500–512) suggests that primitive pigs and peccaries developed different population structures and that the initial canine modification in pigs was a response to social selection pressure. H. Frädrich examines social behavior in pigs and compares it with that of peccaries in "A Comparison of Behaviour in the *Suidae*," an article in a two-volume publication, *The Behaviour of Ungulates and its Relation to Management*, edited by V. Geist and F. Walther (Morges: IUCN, 1974). This work also includes L.K. Sowl's "Social Behaviour of the Collared Peccary, *Dicotyles tajacu (L.)*." Another piece by Sowls is "Reproduction in the Collared Peccary," a chapter in *Comparative Biology of Reproduction in Mammals*, edited by R.W. Rowlands (London: Zoological Society of London, 1966). While researching techniques of trapping, tagging, and transplanting the collared peccary, B.J. Neal obtained "miscellaneous information" on the animal's life history, such as its breeding habits, protective behavior, and parental relations, and established that peccaries are faithful to home ranges. These observations are presented in "A Contribution on the Life History of the Collared Peccary in Arizona" (*American Midland Naturalist*, vol. 61, pp. 177–90). J.A. Bissonette investigates how varying temperatures affect collared peccaries' feeding and bedding behavior in "The Influence of Extremes of Temperature on Activity Patterns of Peccaries" (*The Southwestern Naturalist*, vol. 23, pp. 339–46). R.M. Wetzel introduced the chacoan peccary, which he found in a Paraguay thorn forest, in "The Chacoan Peccary, *Catagonus wagneri (Fusconi)*" (*Bulletin of the Carnegie Museum of Natural History*, vol. 3, pp. 1–36).

Rita Campon

Faces from the Past

Most of the attics in the American Museum of Natural History are tucked beneath the long rooftops and Romanesque towers of the Museum's main building. The attics house an odd assortment of things, from elephant bones to Margaret Mead's old Edison phonograph.

One tower attic, the highest point in the Museum, is reached by climbing a narrow stairway from the sixth-floor storage areas. Echoing down the stairwell is the sound of a mountain stream, created by water circulating in a sprinkler tank. At the top of the stairs is the tank itself, guarded by a wooden statue of a woman carved by Northwest Coast Indians a century ago.

An attic room to the right, illuminated by ancient skylights, contains the Museum's large collection of life casts. Shelf after shelf is lined with plaster busts of once-living Indians, Africans, Siberians, Eskimos, and a few Patagonians. They look out over the garret with blank eyes, the only part of a face that cannot be cast. Some of the life casts are identified by name—Mrs. Lost Horse, Thomas Pretty Back, Ghost Face, and Maggie Old Eagle, all Oglala Sioux; Bonifacio, a Patagonian; Ujaragapssug, a Smith Sound Eskimo; Lumbango, a Congo Bahumba; Annie McKay, a Tlingit Indian; Shenandoah, an Oneida; and Joe Colorado, a Cocapa. Other faces are identified only by tribe or culture.

In a far corner of the attic is a pile of cast arms and legs, looking like a broken heap of dolls. These were cast from life in various positions—flexed, extended, relaxed, gripping imaginary objects, and so on.

The life casts were collected in the field about the turn of the century by various Museum curators and scientists, including Franz Boas, Adm. Robert E. Peary, Waldemar Borgoras, and Casper Mayer. Physical anthropology—in particular the study of racial types—had a large following at that time, and expeditions customarily brought back (in addition to the usual baskets, pots, and other aspects of material culture) hundreds of anthropometric measurements, casts, skeletons, and photographs that look like mug shots with front, side, and rear views. It was also common practice to record vast mythological cycles, innumerable afterworld beliefs, legends, and tales in the original languages. The Museum's scientists shared the belief that most aboriginal cultures were doomed and that whatever could be preserved for future study and the common heri-



Sculptor Sigurd Neandross, in his studio in 1908, cradles one of his life casts. AMNH

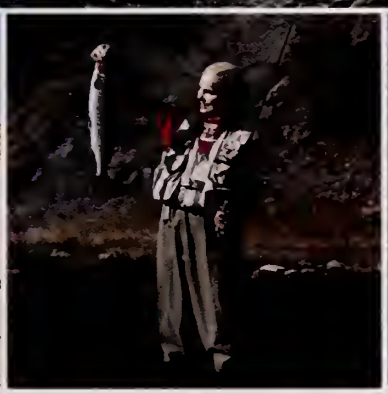
Very easy to take.



HOPEWELL ROCKS, NEW BRUNSWICK



CAVENDISH, PRINCE EDWARD ISLAND



STEWIACKE RIVER, NOVA SCOTIA



WESTERN BROOK GORGE, NEWFOUNDLAND

Your family vacation in Canada's Atlantic provinces is very easy to take, for all kinds of very good reasons.

You are in easy driving distance of our provinces-by-the-sea. And when you cross our friendly border you'll find the roads a lot less crowded.

Or you can fly here. There are major airports in each of the four provinces with national car rentals available at each terminal. Or you can take the ferry. Drive aboard at Portland or Bar Harbor, Maine.

You'll quickly discover why people keep coming back.

Clean, fresh air and miles of uncrowded beaches. The kind of scenery that keeps cameras clicking, majestic highlands and rolling farmlands; silent fiords and tranquil fishing villages. And for a change of pace, sample city life as we live it. Remember, each of the four provinces also offers its own, unique attractions.

You can eat the freshest foods from land and sea. Spend your nights in a farmhouse, or snug in a home by the wave-washed shore. You can bring your tent or trailer, or take your pick from motels, hotels and fine resorts. You will also find your U.S. dollars are worth a whole lot more in Canada. Which means big savings on accommodation, meals, shopping and transportation.

You can swim, sail, golf, play tennis, fish; you can browse around, go to the theatre; or simply sit back and relax, knowing you are always welcome.

This vacation, come to Canada's Atlantic provinces. Very easy to take, but very hard to forget.

New Brunswick
Prince Edward Island
Nova Scotia
Newfoundland and Labrador



Atlantic Canada

For complete information: Seven days a week, 8 a.m. to 9 p.m. eastern time

CALL TOLL-FREE
1-800-341-0358

In Maine, call 1-800-492-0554

AMNH



Life casts, replicated in the Museum's studios, were sold for $12 each.

tage of humanity should be saved at all costs. In short, they collected everything they could think of.

The life casts were shipped to the Museum, where sculptors fashioned busts with accurate hairstyles and ornamentation. During this period the Museum cast copies of the busts and sold them to other institutions for $12 each. The faces were collected for both modelmaking and study in physical anthropology and have been useful for Museum exhibit halls. In the Hall of Plains Indians, for example, the creased and melancholy faces of once-living men and women gaze imperturbably out of glass exhibit cases. Other real faces can be seen in the halls of Eastern Woodland Indians, Northwest Coast Indians, Eskimos, and most recently, in the new Hall of Asian Peoples.

The great Haida canoe at the 77th Street entrance to the Museum is propelled by life casts of Northwest Coast Indians. The Norwegian-American sculptor Sigurd Neandross, who was commissioned to create the figures in 1908, had to develop methods to cast larger body parts such as torsos. Since the weight of plaster distorts soft parts of the body, Neandross began by covering a subject's entire body with paraffin to create a stiff base for the plaster, working up from the feet to the head. Before applying the paraffin he placed threads strategically on the body so that when the plaster had barely set they could be drawn to cut the mold into parts. From the resultant pieces, Neandross cast torsos, arms, and legs to be assembled into figures. He may have cast some of the faces from molds that Franz Boas had made in British Columbia about the turn of the century. Casts of Northwest Coast clothing, masks, and ceremonial objects completed the figures.

The practice of making life casts—often by attaching real but unauthentic bodies to authentic faces—has continued to the present day. The Hall of Asian Peoples has the faces of several nineteenth-century Siberian Yakut; one is attached to the body cast of a young curatorial assistant in the Anthropology Department. Other figures were made from the head and hands of a Buddhist monk, and assorted arms, hands, and feet of willing Museum staff members.

When the South American Hall is built, a few molds now in storage are sure to be cleaned and repoured, and a few more faces will emerge from the tower attic.

Douglas J. Preston

Japanese Textiles

An exhibit of Japanese textiles will open in Gallery 77 on June 25. *Japanese Textile Design* focuses on the designs of the Meiji period (the latter half of the nineteenth century) and includes some of the elaborate stencil patterns used to create the textiles. The appreciation of textile art spanned all levels of Japanese society, and the designs ranged from the creations of established workshops, patronized by wealthy aristocrats, to folk art forms that developed in rural Japan. Among the textiles on display will be *futons* (bed covers), *yutans* (chest covers), and *furoshikis* (textiles used for carrying objects). The exhibit emphasizes the Japanese love of nature and includes compositions displaying such natural objects as bamboo thickets, pine trees, chrysanthemums, peacocks, and butterflies. Many designs reflect Taoist and Zen Buddhist traditions.

A Man For All Time

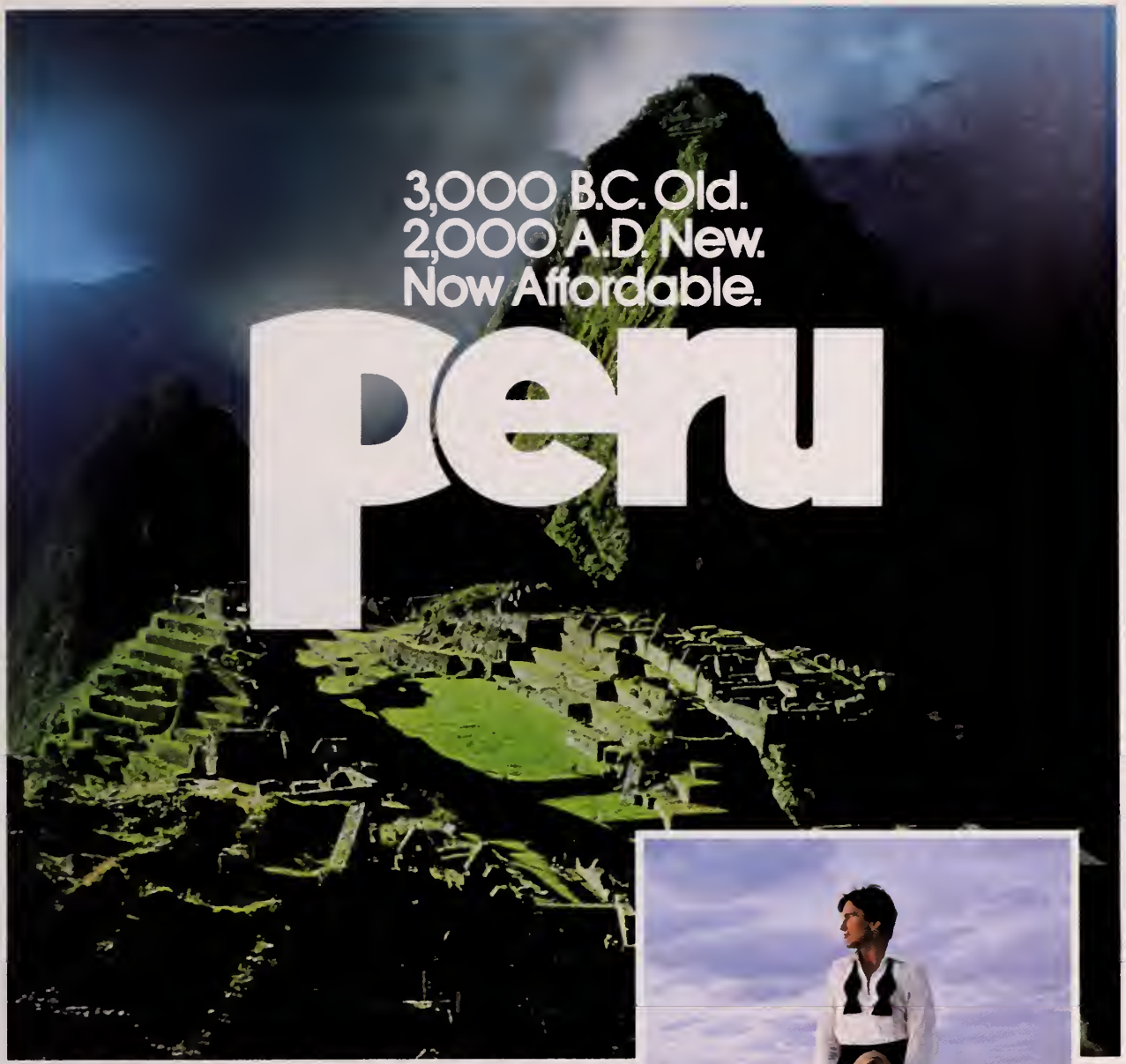
A major exhibition, *Shakespeare: The Globe & the World*, opens at the American Museum of Natural History on Thursday, June 18. The exhibition looks at the Elizabethan era and includes four copies of the first folio of Shakespeare's works, other rare books and manuscripts, prints, paintings, engravings, and sculptures—all from the Folger Shakespeare Library in Washington, D.C. It is the first time the Folger Library has allowed its collection of Shakespeariana—the finest in the world—to leave its halls. Some rare items on display are William Caxton's 1498 edition of Chaucer's *Canterbury Tales*, the personal Bible of Elizabeth I, the 1594 quarto of *Titus Andronicus*—the only surviving copy of Shakespeare's first published play—and an illuminated prayer book presented to Henry VIII by his fourth wife, Anne of Cleves. *Shakespeare: The Globe & the World* also presents film and video clips of some modern presentations of Shakespeare's plays, including Zeffirelli's *Romeo and Juliet* and Kurosawa's *Throne of Blood* (*Macbeth*).

According to Thomas D. Nicholson, director of the Museum, "The exhibition presents a humanist world view that shaped Shakespeare's era, a time that included the birth of modern science and the age of exploration, areas of special interest to the Museum."

Shakespeare: The Globe & the World will coincide with *Shakespeare Summerfest*, a celebration of the Elizabethan age in performances, films, lectures, and concerts in the Museum and throughout the New York City area. The exhibition is made possible by grants from the National Endowment for the Humanities, Metropolitan Life Insurance Company, Exxon Corporation, and the Corporation for Public Broadcasting. It will close September 20.

June Events

Because of planned renovations to the Museum's Auditorium, the schedule for June events at the Museum is not ready at press time. To find out about June events, write to the Department of Education, American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024 and request a copy of the program brochure. Information about programs can also be obtained by calling (212) 873-7507.



The world is still wondering how a people who had not yet conceived of the wheel, managed to plan and build Machu Picchu, a city so advanced in architecture and road system.

It is not within the power of words to convey the visual excitement of Peru. This is a country so varied that it makes you wonder how man ever learned to dominate it. With the ocean, the Andes and the Amazon competing for attention, the eye is forever engaged. No other combination of elements could exert such an hypnotic effect on the visitor.

In dramatic contrast with its incomparable antiquities is Peru's modern capital, stunning Lima. However traveled, the tourist will not have found more impressive hotels on either side of the ocean, nor enjoyed more interesting food so graciously served.

It is often said that Lima is like a huge museum, with such religious and historical relics as the Cathedral on the Plaza de Armas where the remains of the conquistador, Pizarro, are displayed in a glass coffin. Nearby is the church of San Francisco, with catacombs rivaling those of Rome and priceless art treasures by well known masters.

Today, Peru is still beyond your imagination, but is no longer beyond your budget. See your travel agent or send for full-color literature that tells you everything you ought to see and ought to know about Peru.



Peru
PERUVIAN TOURISM PROMOTION FUND
7833 Haskell Avenue
Van Nuys, California 91406

NAME _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

MY TRAVEL AGENT IS _____

NH/6/81

The Lime That Failed

The tasty Key lime has been replaced by a fruit more suitable to the needs of mass-scale agriculture

by Raymond Sokolov

Some people go to Key West for the fishing. Others are attracted by the sunsets in this southernmost American town. Preservationists like to stroll among the island's old homes, visiting the Hemingway mansion or admiring the double elephant folios in the handsomely renovated place where Audubon sojourned while spying on the birds of the Keys and the Dry Tortugas. Many picturesque bars beckon those in search of a bibulous vacation, and in Key West's generally permissive atmosphere, gay people have established a discreet niche. Myself, I drove down from Miami, 160 miles on a highway that arches over the water from key to key, impelled by a lifelong desire to taste an authentic Key lime pie.

As I crossed the last bridge, from Stock Island onto Key West, I assumed I was only minutes from enjoying a rich slice of Florida's most famous regional specialty. But after a week of stuffing down piece after piece of one so-called Key lime pie after another, intermitted by various limeades and lime daiquiris supposedly based on the juice of the small, thin-skinned, legendarily sour and aromatic fruit known as *Citrus aurantifolia,* I came to realize that probably none of these pies or potions contained a single drop of freshly squeezed Key lime juice.

Indeed, after some serious inquiry among local experts, I am now morally certain that virtually all "Key lime" pies and drinks not prepared in private homes in the Keys are actually made with the juice of the Tahiti (or Persian or Bearss) lime, which is not a true lime at all. This hybrid of mysterious origin is the "lime" sold in supermarkets all over the country. Grown primarily in southern Florida and eastern Mexico, it is a satisfactory fruit, but it is not at all the equal of its cousin, *C. aurantifolia* (a.k.a. Key lime, Mexican lime, or West Indian lime).

Roughly twice as large as the Key lime, the Tahiti has a thick skin and looks enough like a small lemon, right down to its pointy end, that it is marketed while its rind is still an immature green. At maturity, Tahitis (and Key limes) turn yellow, and it would be easy for a consumer to confuse Tahitis and lemons. No one, however, would make this mistake with mature yellow Key limes, which are almost perfectly spherical. Sliced open, both varieties of lime are yellow green inside, but Tahitis are seedless, while most Keys have several seeds. Thin-skinned Keys can be easily juiced by pressing them between the thumb and forefinger. And, most important of all, the juice of the Key lime tastes decisively different from the juice of the Tahiti. It is sourer and more complex. In other words, Key lime juice has more personality.

I tested this in a comparative tasting. I also have finally managed to taste a real Key lime pie. And I must insist that, contrary to the opinion of innumerable cookbook authors who claim that "regular" lime juice is a completely adequate substitute, the real thing is far tangier and more interesting than "Key lime" pies that are made with Tahiti juice. The peel, often grated into pie fillings, may also play a role, as Key limes contain a distinctive essential oil in their peels, which is extracted industrially for cosmetics and for commercial flavoring. You can smell the delicious aroma easily if you hold the fruit to your nose.

It does not take a particularly educated nose or palate to appreciate the superiority and the greater sophistication of the Key lime. The problem is to find a Key lime.

In Key West, I made the rounds of local markets and fancy fruiterers in vain. Restaurants and drink stands used either Tahitis or a bottled juice sold in souvenir stands. This dull beverage, suspiciously labeled "real lime" juice, may, of course, be a chemically stabilized juice of real Key limes, but I doubt it. In any case, it is obviously not fresh juice, and anyone who has ever tasted freshly squeezed orange juice against juice that has been frozen or canned or merely stored in the refrigerator will know that the flavor of citrus juice degrades rapidly.

Far and away the strongest argument against the likelihood of any commercial American Key lime product being made from Key limes is that there is no regular commercial source of Key limes in the Florida Keys or anywhere else in the country. According to reliable authority, the last remaining sizable grove of trees is located at Islamorada, about midway between Miami and Key West, in the backyard of a restaurateur who freezes the juice he produces and uses it entirely for his own restaurant.

The persistent gastroethnographer can, nevertheless, lay his hands on fresh Key limes in the Florida Keys. But it helps if you know a Conch. Conchs are indigenous residents of the Keys (nicknamed after a shellfish abundant in local waters). Some Conchs have thorny little Key lime trees in their backyards. I located a luxuriant fruit-bearing tree on the

Photographs by Adelaide de Menil



Manny and Issa pick limes from their own trees

grounds of my motel in Key West and two others in a private botanical garden. Manny and Issa's Restaurant in Islamorada generously provided me with a bag of fruit. It would evidently not be difficult to find other small-scale private sources. But all these trees are mere remnants of what was once a thriving agricultural industry in the Keys and in the southern tip of the Florida mainland, where tropical weather and the good drainage of rocky soil are favorable to this idiosyncratic plant.

No one knows when the first Key lime was planted in the Keys. Citrus historians agree that the tree originated in Malaysia or eastern India. It was first mentioned in Europe in the thirteenth century, in Italy. Whether Columbus brought seeds of *C. aurantifolia* with him to Haiti in 1493 is a matter of conjecture, but it seems probable, since limes were flourishing on that island in 1520. Limes then spread gradually across the West Indies, westward to Mexico and northward to the Florida Keys, where trees were well established by 1839.

Primarily a home fruit throughout the remainder of the nineteenth century, the lime became a commercial crop in the Keys after 1906, when the combination of a severe hurricane and soil depletion forced Conchs to abandon pineapple culture. The Key lime was an ideal replacement since it thrives when meagerly fed. Lime production in the Keys peaked about 1923. Shortly afterward, the hurricane of 1926 dealt the Florida lime groves a death blow. The groves were never restored. It was much easier to exploit the same land as residential real estate for northern vacationers and retirees

or to replant it with more practical crops. One of these was the anomalous Tahiti lime. It probably arose from a chance cross in California, which imported large quantities of citrus fruit from Tahiti between 1850 to 1880. In any case, Tahiti limes were growing in Florida at least by 1883. Today, they are, to all intents and purposes, the only lime grown in the United States. Tahitis are also produced in Mexico, but primarily for export. Mexicans prefer true (Key) limes and pay a premium price for them, nearly twice what they will pay for Tahiti limes. No doubt smiling scornfully, Mexicans send us 16,620 metric tons of Tahitis in a year, but only about 62 tons of real limes, which are shipped into California and Arizona.

Americans, typically, have settled for a hybrid fruit of demonstrably inferior quality, but with ideal qualifications for modern agribusiness. The Tahiti lime is bigger and lends itself to mass-scale agriculture far more easily than the Key lime because it keeps better, has no thorns, and grows a thick skin perfect for machine handling and long truck trips. Of course, life in these United States goes on well enough without the Key lime. The traditional Key lime pie—a graham cracker shell filled with a sour custard made from juice, egg yolks, and sweetened condensed milk—tastes almost as good made with Tahiti lime juice. On the other hand, it is undeniably a fake.

Because of agronomic and financial reasons having nothing to do with food quality, we are all duped in a small way every time we buy a lime and get a convenient substitute. We are defrauded whenever we order a Key lime pie and are served a surrogate. And we are the victims of a horticultural shell game if we believe the Key lime is a rare and exotic form of lime. The poorest Caribbean waif can find real limes in his local marketplace, but in America we can only buy Tahiti limes in our glistening supermarkets. Even, or perhaps especially, in the Keys, the conspiracy to hide this botanical masquerade has succeeded almost completely in perpetuating the myth of a regional dish that actually disappeared, as far as the general public is concerned, almost as soon as it had been invented.

Raymond Sokolov, a writer with an interest in the history and preparation of food, is editor of Book Digest.



Gene Barnes's Key Lime Pie

(Adapted from *The Loaves and Fishes Cookbook,* by Susan Costner and Devon S. Fredricks, Wallflower Press, Box 1275, Bridgehampton, NY 11932)

- 6 egg yolks, beaten
- 1 15-ounce can sweetened condensed milk
- 2 tablespoons evaporated milk
- ½ cup freshly squeezed Key lime juice
- 1 tablespoon grated lime peel
- 1 recipe graham cracker crust (see below)
- ½ pint heavy cream, whipped

1. Beat together the egg yolks, the condensed milk, and the evaporated milk until smooth.
2. Stir in the lime juice and lime peel.
3. Line a 9-inch pie tin with the graham cracker crust.
4. Fill the crust with egg-milk-lime mixture.
5. Freeze.
6. When the filling has solidified, spread the top with whipped cream.

Yield: 8 servings

Graham Cracker Crust

- 1¾ cups graham cracker crumbs
- ½ cup sugar
- ⅓ cup butter, melted

Work all the ingredients together. This crust is meant to be pressed into the pie tin by hand, not rolled.

Old Sour

(From *Conch Cooking,* Florida Keys Printing & Publishing, 405 Fleming St., Key West, Fla. 33040)

- 2 cups Key lime juice
- 1 tablespoon salt

1. Use ripe yellow limes only. Mix the salt and lime juice and let stand for a while. Strain through two layers of cheesecloth as often as necessary to let the juice run through freely.
2. Put the juice into bottles and let stand several weeks before using. Some say old sour should be put into bottles of brown or green glass; others say it makes no difference.

Raw Conch Salad

Skin the conchs and mince very fine. Chop onions very fine. Add salt, pepper, and old sour or fresh lime juice. Let stand at least an hour to blend. Serve without lettuce. (Note: The recipe lacks quantities, but the resourceful cook will add enough onion to invigorate the salad without overwhelming it.) Salt and pepper should also be added "to taste." Use enough old sour or lime juice to moisten the conch bits and "cook" them, as in seviche.



"WHICH VOLKSWAGEN IS THIS?"

Whoever it was that said no product can be all things to all people obviously never drove a Jetta.

Because it's all our Volkswagens in one.

Hard to believe?

"ALL OF THEM."

It was even harder to achieve.

First, we made the Jetta handle like a Scirocco. By giving it rack-and-pinion steering, front-wheel drive, 4-wheel independent suspension and a powerful CIS fuel-injected engine.

Then, we made it luxurious like a Dasher.

With room enough to give a family of four the luxury of stretching their legs.

We even made the Jetta economical like a Rabbit.

How economical?

How about an EPA estimated 25 mpg, 40 mpg highway estimate? (Use "estimated mpg" for comparisons. Your mileage may vary with weather, speed and trip length. Actual highway mileage will probably be less.)

And, finally, we made sure the Jetta was meticulously designed, like a Jetta.

With attention-getting European styling, careful attention to even the smallest detail and a trunk large enough to handle 8 suitcases.

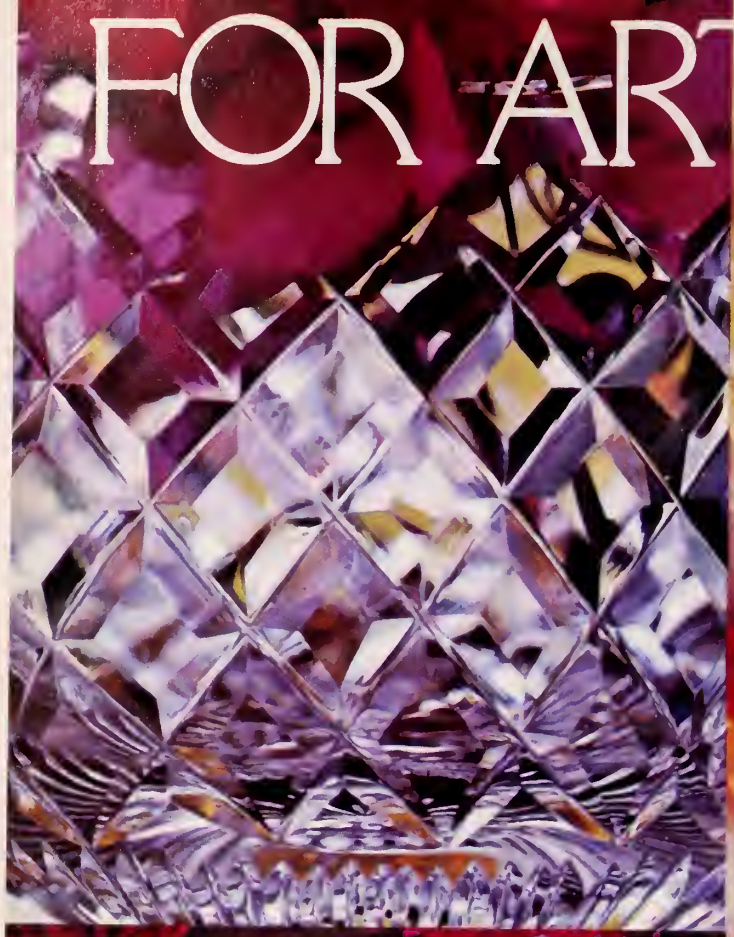
So now, thanks to Jetta, when a salesman asks if you want a performance car, a luxury car or an economy car, you can be decisive and say:

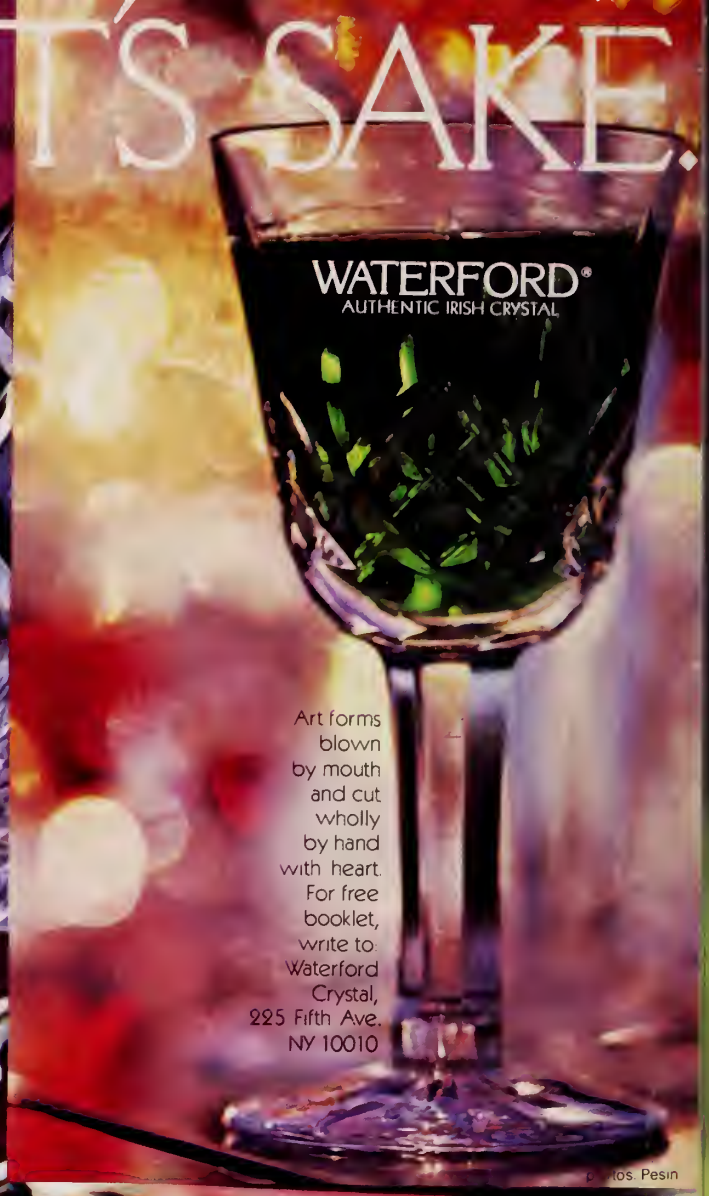
"All of them."

ALL OUR BEST IDEAS IN ONE CAR. JETTA.

© 1981 VOLKSWAGEN OF AMERICA

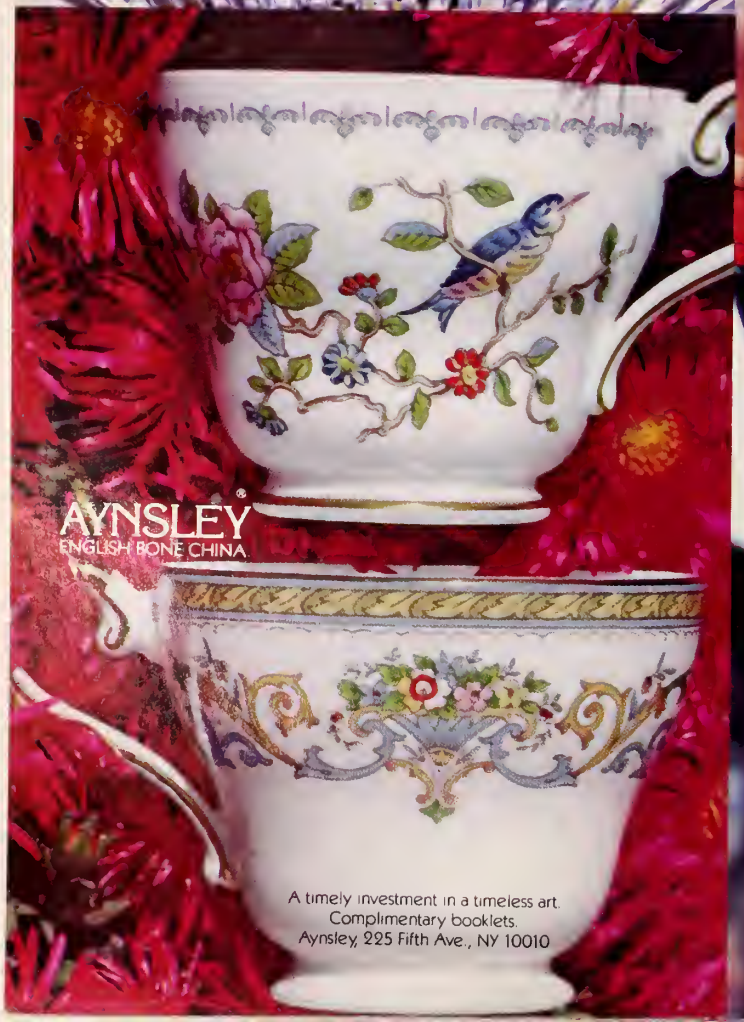
FOR ART'S SAKE.





Art forms blown by mouth and cut wholly by hand with heart. For free booklet, write to: Waterford Crystal, 225 Fifth Ave. NY 10010

Photos: Pesin



A timely investment in a timeless art. Complimentary booklets. Aynsley, 225 Fifth Ave., NY 10010



5.06(747)N1
Ref.

NATURAL HISTORY



7/81



ANNOUNCING BY CADILLAC *Cimarron*

Quick-handling. Road-hugging. And fun to drive. This . . . is Cimarron. An efficient new kind of Cadillac. With the traction of front-wheel drive . . . MacPherson strut front suspension . . . and power-assisted rack and pinion steering with responsive 14:1 steering gear ratio. Plus, it has Cadillac refinements such as genuine leather seating areas, body-contoured bucket seats, air conditioning and more. All standard. Test-drive Cimarron by Cadillac. Due to limited initial production, Cimarron is not available at all Cadillac dealers at this time.

42 HWY EST 26* EPA EST MPG

*Use estimated mpg for comparison. Your mileage may differ depending on speed, distance, weather. Actual highway mileage lower. Cadillacs are equipped with GM-built engines produced by various divisions. See your Cadillac dealer for details.

A NEW KIND OF CADILLAC FOR A NEW KIND OF CADILLAC OWNER.



GM

NATURAL HISTORY

Vol. 90, No. 7, July 1981

American Museum of Natural History
Robert G. Goelet, President
Thomas D. Nicholson, Director

Alan Ternes, Editor
Judith Friedman, Managing Editor
Thomas Page, Designer
Board of Editors:
Sally Lindsay, Frederick Hartmann, Vittorio Maestro, Rebecca B. Finnell
Carol Breslin, Book Reviews Editor
Florence G. Edelstein, Copy Chief
Rita Campon, Copy Editor
Angela Soccodato, Art Asst.
Kay Zakariasen, Picture Editor
Douglas J. Preston, Publications Editor
Susan Rosenberg, Editorial Asst.
Lillian Berger
Editorial Advisers:
Malcolm Arth, James W. Atz, Niles Eldredge, Kenneth L. Franklin, E.Craig Morris, Norman Newell, Thomas D. Nicholson, Martin Prinz, Gerard Piel, Nina Root

David D. Ryus, Publisher
Bradford D. Smith, Business Manager
Frederick E. Grossman, Production Mgr.
Debra Buck McCord, Asst. Production Mgr.
Ernestine Weindorf, Administrative Asst.
Elaine M. Callender, Advtg. Production Mgr.
Lauren Krenzel

Daniel J. Dynan, Asst. Circulation Mgr.
Bob Bruno, Fulfillment Mgr.
Ramón E. Alvarez, Circulation Asst.

NATURAL HISTORY *(ISSN 0028-0712), incorporating Nature Magazine, is published monthly by the American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024. Subscriptions: $15.00 a year. In Canada and all other countries: $18.00 a year. Second-class postage paid at New York, N.Y. and at additional offices.*

Copyright © 1981 by American Museum of Natural History. All rights reserved. No part of this periodical may be reproduced without written consent of Natural History. *The opinions expressed by authors do not necessarily reflect the policy of the American Museum.*

Natural History *is indexed in* Reader's Guide to Periodical Literature.

Advertising Offices:
Natural History Sales
488 Madison Avenue
New York, N.Y. 10022
President of Sales, Arthur Hill Diedrick
Advertising Manager, Katherine José

Telephone Numbers:
Advertising Sales (212) 826-9467
Museum Information (212) 873-4225
Subscription Orders (800) 247-5470
(800) 532-1272 (in Iowa)

Change of address notices, undeliverable copies, orders for subscriptions, and other mail items are to be sent to
Natural History Membership Services
Box 4300
Bergenfield, New Jersey 07621

2 Authors

6 This View of Life *Stephen Jay Gould*
What, if Anything, Is a Zebra?

14 The Tourist as Pilgrim *Colin Turnbull*
A Pilgrimage in India

24 Sky Reporter *Stephen P. Maran*
Seeing Double and Seeing Triple

30 Bios *Robert E. Cook*
Plant Parenthood

36 The Hole Shrimp Story *Marjorie L. Reaka*
The aggressive mantis shrimps become reclusive softies during molting.

44 Leave It to Beaver *Photographs by Johnny Johnson*
In Alaska, summer is a time for these busy animals to prepare for winter.

50 The Origin of High Andean Birds *François Vuilleumier*
To put together the pieces of this complex puzzle, the biologist must be a superdetective.

57 July–December 1981 Poster-Calendar
A handsome bonus for the readers of Natural History

66 Winners of the 1981 Natural History Photographic Competition
An eighteen-page portfolio of striking, often colorful images from our natural world, past and present.

86 Books in Review *Valerius Geist*
Nomads' Best Friend

90 Celestial Events *Thomas D. Nicholson*

92 At the American Museum
The Once and Future Museum

98 Additional Reading

100 A Matter of Taste *Raymond Sokolov*
A Fish Story

Cover: *A female mosquito leaves the pupal stage and emerges from a marsh environment in Oxford, England. The photograph, one in a prizewinning sequence in our 1981 Photographic Competition, was taken by G.I. Bernard. A portfolio of prizewinners begins on page 66.*

IF YOU ARE A
TALL OR BIG MAN



COTTON-EASE™ By Arrow

Dress Shirt

CHECK THIS SHORT-SLEEVE SHIRT FROM ARROW® It's cool, immaculate cotton that comes out of the machine-dryer well-groomed, ready to wear Status checks get a blue chip fashion rating And so does the tailoring for comfort with new collar, pocket, tails Cotton-Ease™ is the secret of its carefree ways — Sanfor-Set® to shrug off wrinkles in the dryer A real mover — why not order one in each color Full cut

$22.00

FOR TALL & EXTRA TALL MEN — SHORT SLEEVE Sizes 16 to 18½

QTY	STYLE & DESCRIPTION	SIZE	PRICE
	No 7945 Blue Check		
	No 7946 Tan Check		

FOR BIG MEN — SHORT SLEEVE Sizes 17 to 20 ½ sizes to 19

QTY	STYLE & DESCRIPTION	SIZE	PRICE
	No 7947 Blue Check		
	No 7948 Tan Check		
	Shipping & Insurance		$2 20
	TOTAL AMOUNT		

☐ Check Enclosed ☐ Charge my Credit Card

☐AMERICAN EXPRESS ☐VISA ☐MASTERCARD

CARD NO

4-Digit Interbank No

Month Year

Expiration Date

Signature (as it appears on your card)

My Telephone Number

Name

Address

City State Zip

☐ CHECK HERE FOR FREE CATALOG

THE King-Size CO.

4341 King-Size Bldg Brockton, MA 02402

Authors

The son of a sculptor who works primarily with animal figures and the grandson of a watchmaker whose hobby was natural history, **François Vuilleumier** came by his interest in animals naturally. As a boy growing up in Geneva, he was frustrated by the nocturnal nature of most mammals in the area and began studying birds. In 1964, inspired in part by a desire to see the Indian dancers of the Bolivian high plateau, Vuilleumier made his first field trip to the Andes. Since then he has returned many times to continue his research on species formation and the biogeography of Andean birds. Vuilleumier, who received his Ph.D. from Harvard University, is a curator in the Department of Ornithology at the American Museum.



In 1967 **Marjorie L. Reaka**, then studying at the Bermuda Biological Station, became interested in stomatopods, or mantis shrimps, when she noticed their startling aggressive behavior. Now an assistant professor in the Department of Zoology at the University of Maryland, she has done fieldwork on the competition for space and food among coral-dwelling stomatopods and studied their rates of evolution. She has also examined the impact of fish predation on a variety of stomatopod species. Reaka has plans to study the rate of biodegradation of coral reefs, with special emphasis on organisms that bore into live and dead coral substrates.





Selling at around $4, Taylor California Cellars varietal wines are an outstanding value. Because they're better than the leading varietals in their price range. But don't take our word for it.

Read what one of the world's leading wine experts, Steven Spurrier, has to say about our Chardonnay: "It's dry, fresh and clean-tasting, with more character than I ever expected to find in a wine at the price. I'm especially impressed by the fruit/acid balance. All in all, this wine is really quite an achievement."

Enjoy Taylor California Cellars Chardonnay, as well as our other exceptional varietals—Zinfandel, Cabernet Sauvignon, Chenin Blanc, Riesling and Sauvignon Blanc. Around $4.00.



© 1981 TAYLOR CALIFORNIA CELLARS
GONZALES, CALIFORNIA 93926

Varietal wines from Taylor® California Cellars™. Better wines. Judge for yourself.

We're #1 to the world.



For two good reasons.

More people fly on Pan Am from America to places overseas than on any other airline.

Because Pan Am provides more of what demanding travelers demand.

Comfort and convenience.

For example, take comfort. To the Pan Am passenger, that may mean the unabashed luxury of First Class. With its spacious cabin and Sleeperette seats. (A Pan Am first, we might add.)

Or comfort could be Clipper® Class. Our separate section especially for business travelers. In Clipper Class, no one sits in the middle. No matter where in the world one is flying.

Sleeperette service® and Clipper Class are available on most of our widebodies. And we've got more widebodies than any other airline.

But offering more widebodies is just the beginning of our convenience story. For another chapter, consider this:

Pan Am can take passengers from more of the U.S. to more of the world than any other airline. From 25 U.S. cities to 47 cities around the world.

All with one ticket. One baggage check-in. On one airline.

If all this isn't reason enough to get you to fly us, we've got more coming. More ways to make your trip even more comfortable. Even more convenient.

Because at Pan Am, we intend to keep on giving you reasons for making us your number one choice.

Say hello to Pan Am.

United States
Detroit
Ft. Lauderdale / Hollywood
Fort Myers
Honolulu
Houston
Jacksonville
Las Vegas
Los Angeles
Melbourne
Miami
Mobile
Newark
New Orleans
New York
Norfolk
Orlando
Pensacola
Phoenix
San Diego
San Francisco
Sarasota / Bradenton
Seattle / Tacoma
Tampa / St. Pete
Washington, D.C.
West Palm Beach

Caribbean
San Juan

Central and South America
Buenos Aires
Caracas
Guatemala City
Maracaibo
Mexico City
Montevideo
Panama City
Rio de Janeiro
San José
Santiago de Chile*
São Paulo

Europe
Berlin
Frankfurt
Hamburg
London
Munich
Nuremberg
Paris
Rome
Stuttgart
Warsaw

The Middle East and Africa
Abidjan
Accra
Ankara
Bahrain
Dakar
Dhahran
Istanbul
Lagos
Monrovia
Nairobi

The Far East and Pacific
Auckland
Bangkok
Beijing (Peking)
Bombay
Delhi
Guam
Hong Kong
Karachi
Manila
Melbourne
Osaka
Shanghai
Singapore
Sydney
Tokyo

*Subject to government approval

PAN AM

What, if Anything, Is a Zebra?

Are the three species a genealogical unit or a disparate group of horses with some confusing similarities?

by Stephen Jay Gould

Each year, professional scientists scan thousands of titles, read hundreds of abstracts, and study a few papers in depth. Since titles are the commonest, and usually the only, form of contact between writers and potential readers in the great glut of scientific literature, catchy items are appreciated and remembered, but unfortunately rare. Every scientist has his favorite title. Mine was coined by paleontologist Albert E. Wood in 1957: "What, if Anything, Is a Rabbit?" (*Evolution*, vol. 11, pp. 417–25).

Wood's question may have been wry, but his conclusion was ringing: rabbits and their relatives form a coherent, well-defined order of mammals, not particularly close to rodents in evolutionary descent. (And thank goodness for small favors as I write this column on a quiet Easter Sunday evening.) I was reminded of Wood's title last month when I read a serious challenge to the integrity of a personal favorite among mammals: the zebra. Now don't get too agitated. I am not trying to turn the world of received opinion upside down. Striped horses manifestly exist. But do they form a true evolutionary unit? With "Stripes Do Not a Zebra Make"—a quite respectable title in its own right—Debra K. Bennett has forced us to extend Wood's question to another group of mammals (*Systematic Zoology*, vol. 29, pp. 272–87). What, if anything, is a zebra?

Since evolutionary descent is our criterion for biological ordering, we define groups of animals by their genealogy. We do not join together two distantly related groups because their members have independently evolved some similar features. Humans and bottle-nosed dolphins, for example, share the pinnacle of brain size among mammals. But we do not, for this reason, establish the taxonomic group Psychozoa to house both species—for dolphins are more closely related by descent with whales and humans with apes. We follow the same principles in our own genealogies. A boy with Down's syndrome is still his parents' son and not, by reason of his affliction, more closely related to other Down's children, no matter how long the list of similar features.

The potential dilemma for zebras is simply stated: they exist as three species, all with black-and-white stripes to be sure, but differing notably in both numbers of stripes and their patterns. (A fourth species, the quagga, became extinct early in this century; it formed stripes only on its neck and forequarters.) These three species are all members of the genus *Equus*, as are true horses, asses, and donkeys. (In this essay, I use "horse" in the generic sense to specify all members of *Equus*, including asses and zebras. When I mean Old Dobbin or Man o'War, I will write "true horses.") The integrity of zebras then hinges on the answer to a single question: Do these three species form a single evolutionary unit? Do they share a common ancestor that gave rise to them alone and to no other species of horse? Or are some zebras more closely related by descent to true horses or to asses than they are to other zebras? If this second possibility is an actuality, as Bennett suggests, then horses with black-and-white stripes arose more than once within the genus *Equus*, and there is, in an important evolutionary sense, no such thing as a zebra.

But how can we tell, since no one witnessed the origin of zebra species (or at least australopithecines weren't taking notes at the time), and the fossil record is, in this case, too inadequate to identify events at so fine a scale. During the past twenty years, a set of procedures has been codified within the science of systematics for resolving issues of this kind. The method, called cladistics, is a formalization of procedures that good taxonomists followed intuitively but did not properly express in words, leading to endless quibbling and fuzziness of concepts. A clade is a branch on an evolutionary tree, and cladistics attempts to establish the temporal order of branching for a set of related species.

Cladistics has generated a fearful jargon, and many of its leading exponents in America are among the most contentious scientists I have ever encountered. But behind the names and nastiness lies an important set of principles. Still the clear formulation of principles does not guarantee an unambiguous application in each case—as we shall see for our zebras.

I believe that we can get by with just two terms from the bounty offered by cladists. Two lineages sharing a common ancestor from which no other lineage has sprung form a *sister group*. My brother and I form a sister group (pardon the confusion of gender) because he is my only sib and neither of my parents had any other children.

Cladists attempt to construct hierarchies of sister groups in order to specify temporal order of branching in evolutionary history. For example: gorillas and chimpanzees form a sister group because no other primate species branched from their common ancestor. We may then take the chimp-gorilla sister group as a unit and ask which primate forms a sister group with it. The answer, according to most experts, is us. We now have a sister group with three species, each more closely related to its two partners than to any other species.

We may extend this process indefinitely to form a chart of branching relationships called a cladogram. But



AS LUXURY SEDANS BECOME MORE EXPENSIVE, THEIR INHERENT WORTH BECOMES MORE CRITICAL.

Due to a variety of economic ills, the day has finally arrived when the price of a luxury automobile can rival that of a small house in the country.

A disturbing trend that has forced many otherwise casual automobile buyers to scrutinize their potential purchases as never before.

At BMW we are not alarmed by this newly enlightened consumer.

For when one examines the features that truly matter in a luxury sedan—performance, craftsmanship and resale value—no other expensive automobile justifies its price quite so thoroughly as the BMW 733i.

Accounting, no doubt, for the fact that last year the demand for the BMW 733i outpaced even our most optimistic predictions.

EVOLUTION IS PREFERABLE TO REVOLUTION.

With a certain predictability, automakers reacted to the realities of the 1980's by bringing forth a plethora of "revolutionary" re-engineered cars.

The 733i, however, is hardly the result of a single year's rush to build an enlightened automobile.

Indeed, decades ago, when luxury car manufacturers were building ever larger cars, reckless in their consumption of fuel, BMW was championing such avant-garde concepts as six-cylinder engines, sensible piston displacements and impressive power-to-weight ratios.

The BMW 733i's 3.2-liter, fuel-injected power plant, for example, is the product of millions of miles of testing and refinement—on and off the great racecourses of the world.

Its double-pivot suspension system has been described by Car and Driver magazine as "...the single most significant breakthrough in front suspension design in this decade."

A five-speed standard transmission (automatic is available) affords one the unique opportunity to pick and choose one's own gears.

ELECTRONIC INNOVATION THAT GOES BEYOND A DIGITAL SPEEDOMETER.

On the BMW 733i, our electronic computerized monitoring system (first installed by BMW in 1975) plays a far more important role than mere decoration: it actually improves the car's efficiency.

With every engine revolution a computer receives and assesses signals from sensors deep within the 6-cylinder engine. Then instantly determines the precise air/fuel mixture to be injected into the cylinder ports.

Yet the incongruous note here is that BMW efficiency is not achieved at the expense of the sort of exhilarating performance one expects in a BMW—or the power reserves necessary to maneuver safely even under the most demanding conditions.*

LUXURY, NOT SUPERFICIALITY.

It would be difficult to imagine an appointment or an accessory that has been omitted in the BMW 733i.

Yet, all facets have been biomechanically engineered to achieve the perfect integration of man and machine.

Its seats are anatomically correct buckets and covered in wide rolls of supple leather.

All of its vital controls are within easy reach of the driver. Instruments are large, well-marked and totally visible.

So impressive is the total result that one automotive journalist was moved to write of the BMW 733i, "...to drive it is to know all the wonderful things machines can do for man."

To arrange a thorough test drive, we suggest you phone your nearest BMW dealer at your convenience.

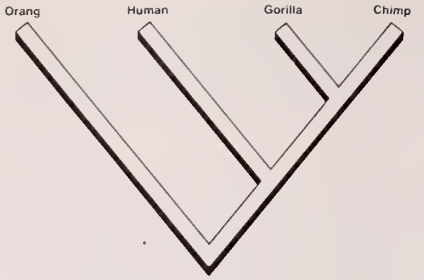
THE ULTIMATE DRIVING MACHINE.

*The 733 (with standard transmission) delivers 16 EPA estimated mpg, 25 estimated highway mileage and, based on these figures, an estimated mpg range of 360 miles and a highway range of 562 miles. (Naturally, our fuel efficiency figures are for comparison purposes only. Your actual mileage and range may vary, depending on speed, weather and trip length. Your actual highway mileage and highway range will most likely be lower.) © 1981 BMW of North America, Inc. The BMW trademark and logo are registered trademarks of Bayerische Motoren Werke A.G.

consider just one more step: What primate species is the sister group to the human-chimp-gorilla unit? Conventional wisdom cites the orangutan, and we add it to our cladogram.

This cladogram of "higher" primates contains an interesting implication: there is no such thing as an ape, at least as usually defined. There may be several species of primates that swing through trees, eat bananas in zoos, and form good prototypes for science fiction of various sorts. But orangs, chimps, and gorillas (the "apes" of our vernacular) are not a genealogical unit because orangs are cladistically more distant from chimps and gorillas than humans are—and we originally defined the term ape to contrast some lesser forms with our exalted state, not to include us!

The zebra problem can also be placed in this context. If the three species of zebras form a sister group (as humans, chimps, and gorillas do on our cladogram), then each is more closely related to its two partners than to any species of horse, and zebras form a true evolutionary unit. But if zebras are like "apes," and another species of horse lies within the cladogram of zebras (as humans lie within the cladogram of traditional apes), then striped horses may share some striking similarities meriting a common vernacular term (like zebra), but they are not a genealogical unit.



Joe Le Monnier

But how do we identify sister groups correctly? Cladists argue that we must search for—and here comes the second term—*shared derived characters* (technically called synapomorphies). Primitive characters are features present in a distant common ancestor; they may be lost or modified independently in several subsequent lineages. We must be careful to avoid primitive characters in searching for common features to identify sister groups, for they spell nothing but trouble and error. Humans and many salamanders have five toes; horses have one. We may not therefore state that humans are more closely related to salamanders than to horses, and that the concept of "mammal" is therefore a fiction. Rather, five toes is an inadmissible primitive character. The common ancestor of all terrestrial vertebrates had five toes. Salamanders and humans have retained the original number. Horses—and whales and cows and snakes and a host of other vertebrates—have lost some or all of their toes.

Derived characters, on the other hand, are features present *only* in members of an immediate lineage. They are unique and newly evolved. All mammals, for example, have hair; no other vertebrate does. Hair is a derived character for the class Mammalia because it evolved but once in the common ancestor of mammals and therefore identifies a true branch on the family tree of vertebrates. Shared derived characters are held in common by two or more lineages and may be used to specify sister groups. If we wish to identify the sister group among tunas, seals, and bobcats, we may use



...And suddenly it was as though I was next to him. I could make out every detail with incredible clarity and brilliance; the moist eyes, each feather stood out in startling detail. It was a moment I would never forget. I was glad I chose Nikons."

It's moments like these that make you glad you didn't settle for anything less than Nikon Binoculars. Their superb optics and uncompromising prism-lock construction are designed to give years of flawless performance even under the toughest conditions.

There are more than 20 Nikon Binoculars to choose from. See them at your Nikon dealer or write Nikon Inc., Dept. 26, 623 Stewart Ave., Garden City, N.Y. 11530.

Nikon

©1981 NIKON INC

hair as a shared derived character to unite the two mammals and to eliminate the fish.

For zebras, the question then becomes: Are stripes a shared derived character of the three species? If so, the species form a sister group and zebras are a genealogical unit. If not, as Bennett argues, then zebras are a disparate group of horses with some confusing similarities.

The method of cladistics is both simple and sensible: establish sequences of sister groups by identifying shared derived characters. Unfortunately, conceptual elegance does not guarantee ease of application. The rub, in this case, lies in determining just what is or is not a shared derived character. We have some rough guidelines, and some seat-of-the-pants feelings, but no unerring formulas. If derived characters are sufficiently "complex," for example, we begin to feel confident that they could not have evolved independently in separate lineages and that their mutual presence therefore indicates common descent.

Chimps and gorillas share a set of complex and apparently independent modifications in several of their chromosomes (mostly "inversions," literally, the turning around of part of a chromosome by breaking, flipping, and reattaching). Since these chromosomal modifications are complex and do not seem to represent an "easy" modification so adaptively necessary that separate lineages might evolve them independently, we mark them as shared derived characters present in the common ancestor of chimps and gorillas, and in no other primate. Hence they identify chimps and gorillas as a sister group.

Unfortunately, most derived characters are more ambiguous. They tend to be easy to construct or so advantageous that several lineages might evolve them independently by natural selection. Many mammals, for example, develop a sagittal crest—a ridge of bone running along the top of the skull from front to back and serving as an attachment site for muscles. Most primates do not have a sagittal crest, in part because large brains make the cranium bulge and leave neither room nor material for such a structure. But a general rule for scaling of the brain in mammals holds that large animals have relatively smaller brains than relatives of diminished body size. Thus the largest primates have a sagittal crest because



their relatively small brains do not impede its formation. (This argument does not apply to the great oddball *Homo sapiens*, with an enormous brain despite its large body.) The largest australopithecine, *Australopithecus boisei*, has a pronounced sagittal crest, while smaller members of the same genus do not. And gorillas have a sagittal crest, while most smaller primates do not. We would make a great error if, using the sagittal crest as a shared derived character, we united an australopithecine with a gorilla in a sister group and linked other, smaller-bodied australopithecines with marmosets, gibbons, and rhesus monkeys. The sagittal crest is a "simple" character, probably part of the potential developmental repertoire for any primate. It comes and goes in evolution, and its mutual presence does not indicate common descent.

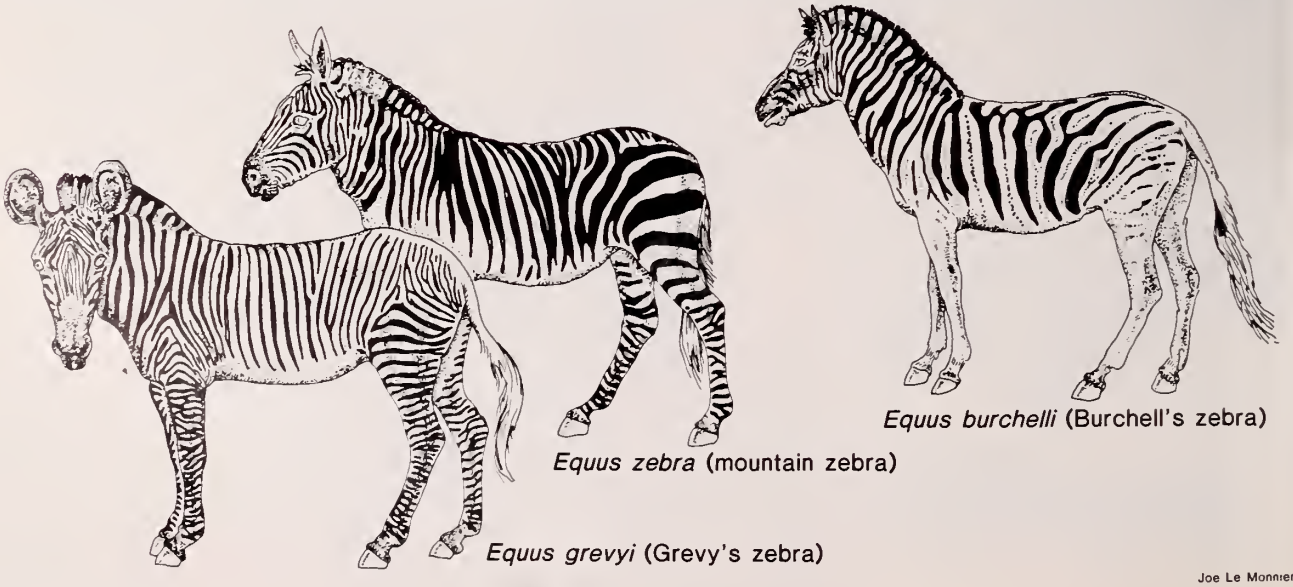
Bennett bases her cladistic analysis of the genus *Equus* on skeletal characters, primarily of the skull. All horses are pretty much alike under the skin, and Bennett has not found any shared derived characters as convincing as the chromosomal similarities of chimps and gorillas. Most of her characters are, by her own admission, more like the sagittal crest—hence the provisional nature of her conclusions.

Bennett argues that the genus *Equus* contains two major cladistic groups—donkeys and asses on one side and true horses and zebras on the other. Thus, zebras pass the first test for consideration as a genealogical unit. Unfortunately (or not, according to your point of view), Bennett claims that they fail the second test. She does identify the Burchell and Grevy zebras (*Equus burchelli* and *E. grevyi*) as a sister group. But in Bennett's scheme, the third species, the mountain, or Hartmann, zebra (*E. zebra*) does not join its cousins to form a larger sister group. Instead, the sister species of the mountain zebra is none other than Old Dobbin himself, the true horse (*E. caballus*)! Thus, mountain zebras join with true horses before they connect with other zebras. Old Dobbin is inextricably intercalated into the cladogram of zebras—and since he is not a zebra by any definition, then what, if anything, is a zebra?

But Bennett's analysis is based upon only three characters, none very secure. All are potentially simple modifications of shape or proportion, not presences or absences of complex structures. All, like the sagittal crest, could come and go. Only one potential shared derived character unites true horses with *E. zebra:* the "orientation of postorbital bars relative to horizontal plane" (a relatively less slanted position for a bar of bone located on the skull behind the eyes—not exactly the stuff of which confident conclusions are made). Only two potential shared derived characters unite Burchell and Grevy zebras: the presence of frontal doming (inflation of the top part of the skull) and relative skull breadth (these two zebras have long and narrow snouts). Unfortunately, we know that at least one of these characters doesn't work very well for Bennett's cladistic scheme because she admits that a member of her other lineage—a horse with the peculiar moniker of the Asiatic half-ass (*E. hemionus*)—has independently evolved a long, narrow snout. If twice, why not three times?

When we look for corroboration to an obvious source—numbers of chromosomes—we are again disappointed. As I discussed in my column of November 1980, the various species of horses, despite their marked similarities of form, differ greatly in numbers of chromosomes. Fusion or fission of chromosomes may be a major mechanism of speciation in mammals, and these differences may therefore have great evolutionary significance. True horses have 64 chromosomes, and one of the zebras shares this number exactly. Unfortunately, it is not *E. zebra*, as Bennett's cladistic scheme would suggest. It is the Grevy zebra, *E. grevyi*. Only two horses have fewer than 50 chromosomes—the mountain zebra with the minimum of 32 and the Burchell zebra with 44—but these species do not form a sister group in Bennett's arrangement. These facts do not necessarily count against Bennett's conclusions, however. Sixty-four could be the original number for the genus *Equus*. In that case, it would be a shared *primitive* character in true horses and Grevy zebras, and would not specify a sister group. Similarly, the shared low chromosome number of mountain and Burchell zebras could represent two independent evolutionary sequences of reduction. Still, there is nothing in the chromosome data that should encourage Bennett.

I conclude that Bennett's proposal is interesting, but very much unproven. Suppose, however, that she is right. What then would a zebra be? Or more specifically, how did cla-



Equus burchelli (Burchell's zebra)

Equus zebra (mountain zebra)

Equus grevyi (Grevy's zebra)

Joe Le Monnier



Is this country in the autumn of its time?

There are those who say this country is in the autumn of its time. That we have lost our pride, and quality no longer is a way of life.

Whirlpool disagrees.

As a maker of home appliances, we believe that pride and quality are so much a part of this country's heritage we must be true to them in everything we make.

Whirlpool believes that this is not the onset of winter but the advent of spring.

A new beginning, where quality will once again become a way of life for everyone.

Whirlpool
Home Appliances

distically unrelated horses get black-and-white stripes? There are two possibilities. Either the common ancestor of zebras and true horses had stripes and true horses lost them, while the three species of "zebras" passively retained them; or else, striping is an inherited developmental capacity of all horses and not so complex a character as it appears. In this case, several separate lineages could acquire stripes independently. This second possibility not only has some evidence going for it, but also raises several interesting issues in evolutionary theory. (I shall have to defer this subject to next month's column. Unlike other unfulfilled promises to discuss a tantalizing subject "next month," I will come through this time, for the piece is already written.) Zebras would then be horses that have realized a potential pathway of development probably common to many or all members of the genus *Equus*.

This cladistic tale of zebras may not hold, but the radical messages of cladistic ordering are secure in many cases. Some of our most common and comforting groups no longer exist if classifications must be based on cladograms. With apologies to Mr. Walton and to so many coastal compatriots in New England, I regret to report that there is surely no such thing as a fish. About 20,000 species of vertebrates have scales and fins and live in water, but they do not form a coherent cladistic group. Some—the lungfishes and the coelacanth in particular—are genealogically close to the creatures that crawled out on land to become amphibians, reptiles, birds, and mammals. In a cladistic ordering of a trout, a lungfish, and any bird or mammal, the lungfish must form a sister group with the sparrow or elephant, leaving the trout in its stream. The characters that form our vernacular concept of "fish" are all shared primitive and do not therefore specify cladistic groups.

At this point, many biologists rebel, and rightly I think. The cladogram of trout, lungfish, and elephant is undoubtedly true as an expression of branching order in time. But must classifications be based only on cladistic information? A coelacanth looks like a fish, tastes like a fish, acts like a fish, and therefore—in some legitimate sense beyond hidebound tradition—*is* a fish.

No debate in evolutionary biology has been more intense during the past decade than the challenge raised by cladistics against traditional schemes of classification. The problem arises from the complexity of the world, not the fuzziness of human thought (although woolliness has made its usual contribution as well). There are two components to our vernacular conception of "similarity" between organisms—and classifications are designed to reflect relative degrees of similarity. On the one hand, we have genealogy, or branching order. Cladistics works with branching order alone, rigorously excluding any other notion of similarity. But what about the admittedly vague and qualitative, but not therefore unimportant, notion of overall similarity in form, function, or biological role? The coelacanth, to say it again, looks and acts like a fish even if its closer cladistic relatives are mammals. Indeed, another theory of classification, called phenetics—from a Greek work for appearance—focuses on overall similarity alone and tries to escape from the charge of subjectivity by insisting that phenetic classifications be based upon large suites of characters, all expressed numerically and processed by computer.

Unfortunately, these two types of information—branching order and overall similarity—do not always yield congruent results. The cladist rejects overall similarity as a snare and delusion and works with branching order alone. The pheneticist attempts to work with overall similarity alone and tries to measure it in the vain pursuit of objectivity. The traditional systematist tries to balance both kinds of information but often falls into hopeless subjectivity because they really do conflict. Coelacanths are like mammals by branching order and like trout by biological role. Thus, the cladists buy potential objectivity at the price of ignoring biologically important information. And the traditionalists curry confusion and subjectivity by trying to balance two legitimate, but often disparate, sources of information. What is to be done?

I cannot answer this question, as it raises issues of style, mores, and methodology more than demonstrable substance. But I can at least comment on the source of this bitter debate—a rather simple point that somehow got lost in the heat. In an ideal world, there would be no conflict among the three schools—cladistics, phenetics, and traditional—and all would produce the same classification for a given set of organisms. In this pipedream world, we would find a perfect correlation between phenetic similarity and recency of common ancestry (branching order); that is, the longer ago two groups of organisms separated from a common ancestor, the more unlike they would have become in appearance and biological role. Cladists would establish an order of branching in time by cataloging shared derived characters. Pheneticists would crunch their numerous measures of similarity in their favorite computers and find the same order because their most dissimilar creatures would have the most ancient common ancestors. Traditionalists, finding complete congruence between their two sources of information, would join the chorused harmony of agreement.

But let the reverie halt. The world is much more interesting than ideal. Phenetic similarity often correlates very poorly with recency of common ancestry. Our ideal world requires a constancy of evolutionary rate in all lineages. But rates are enormously variable. Some lineages change not at all for tens of millions of years; others undergo marked alterations in a mere thousand. When the forebears of terrestrial vertebrates first split off from a common ancestry with coelacanths, they were still unambiguously fish in appearance. But they have evolved, along numerous lines during some 250 million years, into frogs, dinosaurs, flamingos, and rhinoceroses. Coelacanths, on the other hand, are still coelacanths. By branching order, the modern coelacanth may be closer to a rhino than a tuna. But while rhinos, on a rapidly evolving line, are now so different from that distant common ancestor, coelacanths still look and act like fish—and we might as well say so. Cladists will put them with rhinos, pheneticists with tunas; traditionalists will hone their rhetoric to defend a necessarily subjective decision.

Nature has imposed this conflict upon science by decreeing, through the workings of evolution, such unequal rates of change among lineages and such a poor correlation between phenetic similarity and recency of common ancestry. I do not believe that nature frustrates us by design, but I rejoice in her intransigence nonetheless.

Stephen Jay Gould teaches biology, geology, and the history of science at Harvard University.



Welcomed from the Grand Canyon to the Grand Canal.

Wherever you're going, it's good to know your BankAmerica Travelers Cheques are welcome in over 150 countries around the world. That's why we call them World Money.® And if your cheques are lost or stolen, it's also good to know you can get refund service at more than 40,000 locations both here and abroad.



BA CHEQUE CORPORATION
A BANKAMERICA COMPANY

BankAmerica Travelers Cheques

They make you feel good all over.

A Pilgrimage in India

Where tourism is economically unthinkable, the pilgrimage may serve a similar function

by Colin Turnbull

While the concept of the tourist as a pilgrim who is searching for more than mere escape might be easy to accept, the notion that tourism and pilgrimage bear more than a superficial resemblance to each other is not. Yet observing American tourists in Europe and the Middle East, I perceive a conscious desire to identify with historical and spiritual roots. There is a moment of fleeting recognition when the tourist says, "Yes, this is who I am, this is where I came from, this is where I really belong." A sense of belonging, to a religious or spiritual heritage rather than a cultural one, is surely the reward of the true pilgrim. So perhaps we have to think in terms of alternative categories of quest, sacred or secular, rather than in terms of alternative institutions.

Still, so fixed is the equation of tourism with escape and holiday-making that we are reluctant to consider it in the same light as the pilgrimage. Yet if we are to understand tourism, we must at least examine the possibility that it is a latter-day form of pilgrimage. We tend to think of tourism as a contemporary phenomenon because only since the introduction of jet aircraft have distant parts of the world become accessible within the short time span of the annual vacation, and only recently has the combination of relative affluence and the credit-card system enabled any but the wealthy to afford extensive travel. But this is not so.

For centuries there has been considerable population movement (with many of the same political, economic, and domestic consequences as tourism) in the form of the pilgrimage. Further, the pilgrimage has generally been available to the poor, as well as the rich; to the unemployed, time is of no concern, and others have received some consideration because of the deserving nature of the enterprise, which frequently entailed hardship, danger, and some sacrifice. But as Chaucer has recounted, the pilgrimage was by no means all hardship nor was it without its profane movements and earthly delights.

We can see the pilgrimage in all its vitality at work in India today, where for the masses tourism is economically unthinkable. And we can immediately see undeniable similarities between the two institutions. Like tourist resorts, sacred shrines quickly acquire both economic and political significance. A tiny village or a solitary dwelling can grow into a sizable town once attention is drawn to it. To support a sizable body of itinerant pilgrims such growth is required, even though it may not be to the liking of the local residents. There are benefits and disadvantages to be had, so pilgrims are received with mixed feelings; like tourists, they are both welcomed and exploited. Pilgrimage in India, like tourism in the West, is the major cause of population movement. All classes are affected, all castes, and although the pilgrimage used to be largely restricted to the elderly, it is now increasingly popular among the young. As a social institution it allows for a temporary breakdown of otherwise inviolable barriers; to some extent it replaces old values with new ones that make a temporary rapprochement possible between otherwise socially segregated individuals and groups. Economic and political horizons are enlarged. For the wealthy, the pilgrimage functions somewhat like a tax write-off, except that the perceived reward for endowing pilgrim rest houses, or *dharmashala*, is more spiritual than economic. Such endowments make it possible for the poorest to travel: for some it is an escape from poverty or unemployment; for others, an escape from the confines of caste and community.

Until the very recent advent of the transistor radio, the pilgrimage was the only way that widely different segments of the Indian population could come to know each other, and that individuals, otherwise isolated for whole lifetimes in local communities, could get some kind of comprehension of the diversity and magnitude of their country. But in addition to serving very specific economic and political functions, the pilgrimage also allows for the fulfillment of personal goals, both secular and sacred. There are different kinds of pilgrimage, each offering different attractions, and choosing one is much like choosing where to go on vacation; you have to decide which of your needs most deserve fulfillment.

In any one community, for instance, there are usually a number of shrines that help bind the community together, and a visit to one or more of these is as much a social as a religious event. But farther afield there are pilgrimages to be undertaken that can last from a week to a year, and there are several major kinds of shrines to choose from, involving primarily either sacred places or sacred people. Places may be divided into two kinds, natural and man-made. Almost any natural wonder is likely to become a shrine, be it a mountain, river, cave, waterfall, hot spring, or even an odd-looking rocky outcrop. Such places become sanctified in myth and may even win scriptural mention, but it is more the simple attraction of nature and the desire to be part of something much vaster, more powerful, and more enduring that draw pilgrims to these places.

At some of these natural shrines great temples arise, such as Tiruvan-

If You Read Music... You'll Love Our Magazine



The Only Magazine You Can Play!

We call it SHEET MUSIC MAGAZINE. And that's exactly what it is! Each and every issue is filled with the most popular sheet music ever published, including *Pop, Great Standards, Jazz, Show Tunes, Folk, Country, Tin Pan Alley, Movie Songs, Classics, Ragtime, Blues,* and more.

When you sit down at your piano, organ, guitar, or any musicial instrument, *we want to be your music book!* And when you want to improve your own musical ability, we want our staff of writers to *show you how.* And in every issue they do just that! There are Keyboard Clinics, Guitar Workshops, Composers' Workshops, Sight-reading, Playing By Ear, Theory And Harmony, Rhythm Workshops, and so much, much more.

A single year's subscription brings you more than 100 great songs. And when you consider the price of sheet music these days, about $1.75 per song, and realize that Sheet Music Magazine provides the exact same thing for less than *15¢ a song,* you can understand why it has more subscribers than any other music magazine in the world today. A one-year subscription for $13.97 brings you over $175 worth of music!

And now you can choose between a *Piano Edition* and an *Organ Edition.* Each edition is specifically arranged for *your* instrument, and includes feature articles of special interest to *you.* Also, you can choose an *easy-to-play* version of the piano edition as well as the organ edition. The *easy-to-play* editions are especially good for you beginners and new students, young or adult, who don't think you are quite ready for the standard and special arrangements found in our standard editions. (If you are undecided as to which version would be right for you, we suggest you try the *Easy Edition.* You can change at any time, at no cost whatsoever.) Check your preference on the subscription application.

Let us send you your first issue with these wonderful songs... *All The Things You Are ... Canadian Sunset ... Hurting Each Other ... I Will Wait For You ... Make Believe ... Smoke Gets In Your Eyes ... They Didn't Believe Me ... Watch What Happens ... Why Do I Love You ... Yesterdays*

SHEET MUSIC MAGAZINE Dept. L1-10-71 352 Evelyn Street, Paramus, N.J. 07652

Please enter my subscription to Sheet Music Magazine and rush me my first issue with all the songs listed above. I understand that I may cancel at any time and receive a complete refund on all unmailed issues. No questions asked.

( ) check one

Piano/Guitar
☐ Easy
☐ Standard

Organ
☐ Easy
☐ Standard

( ) check one
☐ One Year (9 issues) $13.97
☐ Two Years (18 issues) $25.00

Name_____

Address_____

City_____ State_____ Zip_____

☐ I enclose full payment of $_____ (Make check payable to Sheet Music Magazine)

Charge to ☐ Master Charge ☐ Visa

Account No._____ Exp. Date_____

Canadian residents please add $2.00 per year extra for postage

Celestron®





For the photographer, astronomer, naturalist, educator, or casual observer — Celestron has established a new standard in superb telescopes and telephoto lenses at affordable prices (from $295). All feature large observatory mirror/lens type optics folded into a compact, lightweight, portable telescope or telephoto lens. Close-up detail borders on the fabulous from celestial objects light years away, to ships, planes, flowers, wildlife or people. Here is truly an instrument that allows you to observe or photograph the world around you. Celestron also has a full line of binoculars of astronomical quality.



Send $2.00 for 32-page full color catalog on how to select and use a Celestron telescope or telephoto lens.

Celestron International
2835 Columbia St., Box 3578-NH
Torrance, Calif. 90503, U.S.A.
Telephone: (213) 328-9560

(Dealer Inquiries invited.)

namalai in southern India. From the temple's rear walls a path climbs up Arunachala, a holy mountain said to be more ancient than the Himalayas. Elsewhere, temples were built because the site was sanctified by some sacred event. These monuments offer something subtly different from the natural shrines. There is a feeling of being a part of a vast congregation of believers—a member of a faith, of a corporate, rather than individual, body that is both physical and spiritual. It is a feeling that satisfies another kind of need.

The pilgrimage to people, rather than places, is different again. Sacred people, like sacred places, are associated with miracles, and while perhaps all pilgrims hope for some general kind of miracle—their transformation into something bigger, more powerful, more significant—there are some who hope for a specific miracle: the cure for an illness or the resolution of a problem. Both sacred places and sacred people may acquire reputations in this respect, but most people seeking some kind of specific assurance make the pilgrimage to one or another of India's great teachers, or gurus. Some pilgrims may seek even more from a sacred person. They seek their divinity—the ultimate transformation of their secular selves into sacred beings. Such pilgrims, once they find their teacher, devote themselves exclusively to the spiritual quest for the divine. There the parallel with tourism ends.

Pilgrims can be met on almost any train or bus or mountain trail in India, yet we might not recognize them as pilgrims; in most cases we would mistake them for travelers bent on personal pleasure. After all, most of their time is spent traveling to and from the shrine that is their sacred goal, and on the way they enjoy the excitement of travel just as we all do. They are seeing new places and meeting new people. New worlds are being opened up to them at each stage of the journey. This is true even for those who regard every step of the journey itself as a sacred act. The Indian pilgrim route is dotted with staging posts that become bustling commercial centers catering to the pilgrim's every need. For those who cannot get into the endowed *dharmashala*, there are hotels and restaurants. Small stores and roadside stalls overflow with trinkets and souvenirs, and the streets are filled with beggars selling the peculiar

ware of poverty, for even the poorest pilgrim will try to add to his store of merit by giving to others. Thus the beggars themselves are integral parts of the pilgrim scene, just as they are in many a tourist resort. There are also troupes of players, dancers, and musicians performing wherever they can find enough space, attracting large crowds of excited spectators. And of course there are other sideshows and even more secular forms of entertainment for the pilgrim ready to fall, temporarily, by the wayside.

Such pilgrim centers are graphic examples of the same process of dynamic fission and fusion, a kind of structured anarchy, that characterizes many tourist resorts. Most *dharmashala* are open to all, regardless of class or caste or even of nominal religious affiliation (I was as welcome in most Hindu *dharmashala* as Muslim and Buddhist pilgrims were), but in the larger and less remote centers there may be open discrimination, both regional and religious. It is a way of catering to those who wish to maintain a certain kind of ritual privacy and purity that is respected by others. And while some pilgrims are set apart, others who formerly had no unity are united. The pilgrimage encourages both the strict observance of orthodox rule and the relaxation of ritual regulations, and like tourism, it provides an opportunity for the open demonstration of extremes of both conservatism and free thought. Even at the shrine itself, where the pilgrim is reaching for his broadest identity, say, as a Hindu or as an Indian, there are ways in which he will be reminded of his equally vital but narrower loyalties to region, caste, community, and clan. Some regions, for instance, maintain at a center a resident priest (just as some maintain rest houses for members of their community only) who keeps a record of all pilgrims from his region, testifying to their sacred as well as secular allegiance.

But in the act of worship all secular differences are momentarily banished, and all unite in the realm of the sacred. And an experience need not be mystical to have considerable social consequence. The performance of *puja*, or "worship," the taking of a bath in the sacred tank, or hot spring, the sharing of consecrated food, these are all leveling devices. Afterward the distance is restored, but it is one of difference, rather than of superiority or inferiority. All this happens in any

Take part in the magic and excitement of the Royal Wedding



Facsimile of full-color Souvenir Book

The official Royal Wedding Souvenir Book

No couple has generated such worldwide interest or captured the hearts of so many. The marriage of a future ruling monarch is The Royal Event of the Century!

To commemorate this historic event, The British Collection offers in North America the British Post Office Royal Wedding Souvenir Book. The two actual British Royal Wedding Commemorative Stamps designed for this occasion are showcased on an 8″ x 8″ full-color album containing 16 pages of personal photos of H.R.H. Prince Charles and Lady Diana Spencer, plus past Royal Weddings. Even if you've never collected stamps, you'll take pride and pleasure in owning this magnificent memento of a once-in-a-lifetime event.

British stamps are among the most popular and sought-after philatelic items. As the first major stamp issue depicting this future monarch, the book could take on greater significance to collectors.

Among hundreds of commemoratives of the Royal Wedding, this is the *only* philatelic commemorative from Great Britain approved by the Queen. Because previous Royal Wedding commemoratives have sold very quickly, you are urged to place your reservation today.

Accept my reservation for: WC2NH

Quantity ____ (41004) Royal Wedding Souvenir Books, at the Original Issue Price of $12.95 each $____

Quantity ____ (41012) Royal Wedding Philatelic Packs (includes First Day Cover, Presentation Pack and Postcards), at $10.95 each $____

NY residents add sales tax $____

Total $____

Name

Address

City State Zip

☐ Check or money order to Stanley Gibbons, Inc. enclosed (no cash please)

☐ MasterCard ☐ VISA

Expiration Date____ Mo. Yr

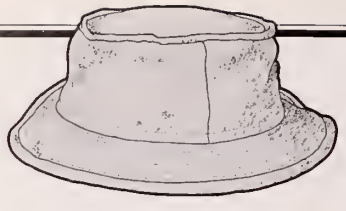
Signature

Shipment begins July 29, 1981

THE BRITISH COLLECTION BY STANLEY GIBBONS

P.O. Box 943, Hicksville, NY 11802

RESERVATIONS NOW BEING ACCEPTED ON A FIRST COME, FIRST SERVED BASIS



THICK 'N THIRSTY TOWELING HAT



Thirsty terry cloth toweling is shaped into a hat that beats summer heat. Use it to wipe your perspiring brow or douse it in water, wring it out and wear it to keep you cool at tennis, golf, boating, fishing, camping. **Sizes:** S(6¾-6⅞), M(7-7⅛), L(7⅛-7⅜), XL(7½-7⅝), XXL(7¾-7⅞). **Colors:** Sailing Blue, Powder Blue, White, Yellow. **Toweling Hat $7.75** ppd.

Order Today! Money Back Guarantee!

Enclosed is my check or money order for $ _____
(Add sales tax where applicable.)

Please RUSH my # 2002 Toweling Hat.

Size _____ Color _____

Name _____

Address _____

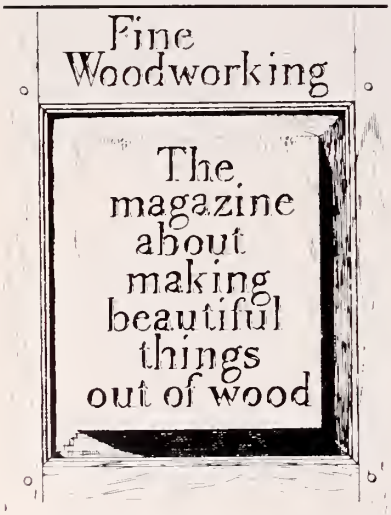
City _____

State _____ Zip _____

☐ Send me your FREE color catalog of quality outdoor apparel and equipment.

Eddie Bauer®

Dept. HNH, Fifth & Union, Seattle, WA 98124



Woodworkers' delight—A subscription to *Fine Woodworking* brings an abundance of ideas and information on cabinetmaking, carving, marquetry and turning—the tools and techniques, materials and design. Carefully edited, beautifully printed. Join the 200,000 readers of this superb bimonthly magazine by sending your name and address, along with your payment, to The Taunton Press, 52 Church Hill Road, Box 355CF, Newtown, CT 06470. One year $14, two years $26, refundable. For gifts, please include both addresses. Visa or MasterCard accepted.

tourist resort; it merely assumes another form.

Having last visited India thirty years ago (when I had come from Oxford on a two-year research fellowship at Benares Hindu University), on this trip I wanted to revisit some of the pilgrim shrines and the places and people I had known so long ago. With a young Brahman official from the great Birla Mandir (temple) in Delhi, I set off by train for Rishikesh, the stepping-off place for the famous triple Himalayan pilgrimage to Badrinath, Jumnotri, and Gangotri. Rishikesh, rather like the rest of India, seemed not to have changed at all in thirty years. As crowded as ever, the streets were filled with boisterous pilgrims and equally boisterous peddlers. The pilgrim season was ending and snow had already closed the shrine of Kedarnath, but even so we were lucky to find a small room in one of the poorer *dharmashala*. It was a typical pilgrim accommodation, an eight-foot-square cell with a clean cement floor and no furniture, only a small grass broom. Traveling as pilgrims, we each carried a blanket, a shawl, and a change of clothes that doubled as a pillow. Most pilgrims prefer unfurnished accommodations for reasons of both ritual and physical purity rather than because of any urge toward self-mortification.

A road of sorts now links Rishikesh with Badrinath, nearly two hundred miles into the mountains near the source of the Alaknanda, a major tributary of the Ganga River. At dawn, Mohan Kumar and I joined the crowd of pilgrims on the streets; about eighty of us managed to get on an ancient vehicle designed to hold a maximum of forty people. Luckily, I did not have a window seat. Even when standing I could see enough of the precipitous drop from the edge of the typically steep, twisting, mountain road to make me feel slightly nauseated. Landslides had swept parts of the road away, and every now and then the outer wheels of the bus dipped alarmingly as the driver negotiated the crumbling verge. Every week there are accidents; not infrequently, busloads of pilgrims fall to the rocky riverbed hundreds of feet below. On our trip, nobody seemed concerned; some passengers even joked about the possibility of "instant transmigration" if they were to fall into the holy river.

This denial of danger cannot be put down to religious fervor alone, although that plays a part. Indeed, some of the older pilgrims hope to die while engaged on a holy pilgrimage, and many journey to sacred places and stay there until they do die. Then pilgrimage becomes more like retirement than tourism. But the same devil-may-care attitude, from a touch of recklessness to the downright courting of disaster, characterizes many tourist and vacation activities, such as sports in which skills are tested as well as courage. For the passengers on the bus to Badrinath, the ride was also a test of faith.

Badrinath is high up in a steeply sloping valley, only a few miles from the Tibetan border. Ice-covered mountains fringe the near horizon, with Nilkanth reaching more than 21,000 feet. In October it was cold and windy but as yet free of snow. The site is not spectacular in any way; the sanctity of the place derives from its location on one of the major sources of the holy river Ganga.

The temple of Badrinarayan is on the far side of the Alaknanda River, across a wooden bridge. It is surrounded by stalls selling trinkets and souvenirs and special foodstuffs that are brought into the temple and blessed, then taken back home for distribution to friends and relatives. Inside the temple courtyard were other stalls occupied mostly by regional priests keeping a roll of all members of their community who came to Badrinath. Most of them had posted elaborate lists of the various *puja* they would perform and at what cost. Mohan Kumar was dismayed to find that he did not have enough money to pay for a *puja* of the kind he wanted. He tried bargaining but that failed, so he settled for something less and insisted on my attending and sharing the blessing with him, although he refused to let me share the cost. I was moved by his devotion and by his enormous excitement at having accomplished a pilgrimage that a very few ever make, and generally only in their later years. I might have been more moved by the *puja* itself, which I remembered well from long ago, but for the fact that a short distance away a number of pilgrims were clustered around a radio that was blaring a broadcast of a championship cricket match being played in Calcutta. I never did like cricket, and the precise English accent of the Indian commentator describing the action added, for

The World Wildlife Fund announces an original work of art in fine, hand-painted porcelain

Surprise!

Inaugurating the World Wildlife Fund's first collection of baby animal sculptures in porcelain.

Issued in a limited edition.

Art of exceptional charm and beauty, at the very attractive price of $45.

For the first time in its history, the World Wildlife Fund has undertaken the creation of a collection of porcelain sculptures of baby animals.

Surprise!, portraying a charming little tiger cub, inaugurates the collection. Crafted in fine hand-painted porcelain, it is a thoroughly delightful work of art. And it will be issued at the very modest price of $45—which may itself be paid in two convenient monthly installments of $22.50 each.

This new and original work of art has been designed for the World Wildlife Fund by Eva Dalberg, one of the world's most talented portraitists of animals. Dalberg was chosen for this commission because she has the unique ability to capture the lovable quality of animals.

Here the little tiger is portrayed in an amusing—and totally unexpected situation. With a bright green butterfly perched right on the tip of his nose! This delightful sculpture will be crafted in fine porcelain and completely hand-painted. So, all the colors and features will be clear, crisp and vibrant. The tiger's orange coat and black stripes, his sparkling black and yellow eyes, his striped tail—and, of course, that devilish little green butterfly.

Surprise! will be crafted for the World Wildlife Fund, under the supervision of Franklin Porcelain of Japan. Each sculpture will be crafted in Taiwan and will be backmarked with the official "WWF" symbol. In addition, a Certificate of Authenticity attesting to its official status and bearing the signature of the Director General of the World Wildlife Fund International, will be included.

In the tradition of classic works in fine porcelain, this enchanting sculpture will be made available in a limited edition, reserved exclusively for those who order from the collection of porcelain animal sculptures during 1981. When all valid orders from these individuals have been filled, the edition will be permanently closed.

You'll enjoy displaying this enchanting little tiger in your home and showing it to all your friends. It will be a conversation piece you will treasure. And you will have the satisfaction of knowing that it is created in a long-established tradition. For, of all porcelain pieces collectors prize, small figures of animals are among the most popular.

To reserve *Surprise!* by Eva Dalberg, you should act promptly. Please be sure that your Reservation Application is sent to the World Wildlife Fund, c/o Franklin Porcelain, Franklin Center, PA. 19091, by August 31, 1981.



RESERVATION APPLICATION

Surprise!

Valid only if postmarked by August 31, 1981

World Wildlife Fund
c/o Franklin Porcelain
Franklin Center, Pennsylvania 19091

Please accept my reservation for *Surprise!* by Eva Dalberg. This original sculpture will be crafted for me in fine hand-painted porcelain.

I understand that I need send no money at this time. I will be billed in two equal monthly installments of $22.50* plus $1.25 for shipping and handling, the first payment due before the work is sent to me.

*Plus my state sales tax

Signature _____
ALL ORDERS ARE SUBJECT TO ACCEPTANCE

Mr.
Mrs.
Ms. _____
PLEASE PRINT CLEARLY

Address _____

City _____

State, Zip _____

Limit: One sculpture per person.

L.L.Bean®
Outdoor Sporting Specialties



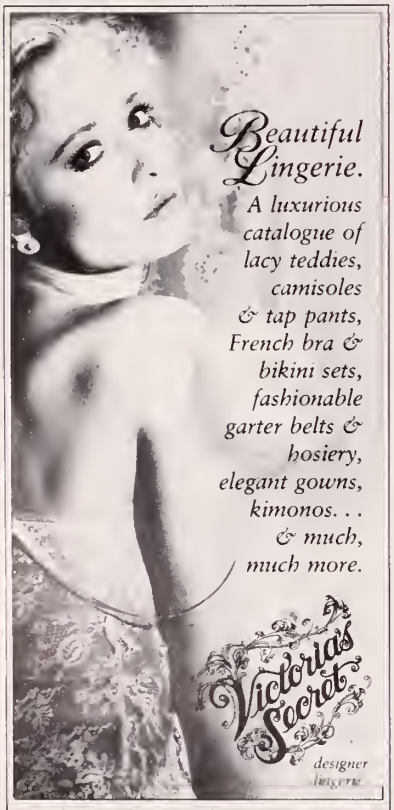
FREE Fall Catalog

Fully illustrated. Features quality apparel and footwear for men, women and children; camping, hunting, hiking and winter sports equipment. For 69 years L. L. Bean has offered practical and functional merchandise at reasonable prices. Our clothing and footwear is rugged enough to withstand active outdoor use, yet attractively styled and comfortable for casual wear. Many items are of our own manufacture. All are guaranteed to be 100% satisfactory.

SEND FREE CATALOG

Name_____
Address _____
City _____
State_____ Zip_____

L. L. Bean, Inc.
736 Casco St., Freeport, ME 04033



Send $3 for catalogue to NH-07
Box 31442, San Francisco CA 94131
Boutiques in San Francisco, Palo Alto & Cupertino, CA

me, a note of falsity that I had not expected in so remote a shrine. Mohan Kumar laughed and said that if I were really a pilgrim, then I would not have even heard the radio, let alone been distracted by it. "By the way," he added, "what *is* the score now?" He was a little critical of me because I had not joined in the ritual bathing in the hot spring that fills a steaming pool right below the temple. I was reminded again of tourism. I had offended him, not because of any desecration, but because I was not getting my money's worth, not taking advantage of all the attractions available to me. But I could not escape from the feeling that I was in a deservedly unfrequented tourist resort and had to walk off into the hills for several miles before I could feel that for me, at least, this was a sacred, rather than secular, pilgrimage.

We all have individual ways of finding the sacred. Some find it in the company of others; some have to be alone or have learned how to isolate ourselves even when in a crowd. Others need something or someone, such as the builders of temples and cathedrals or the generations that have worshiped there before them, to mediate between the sacred and themselves. It is these pilgrims who flock to the man-made shrines. At Badrinath I found no one who had the slightest interest in making the pilgrimage to Jumnotri. Jumnotri and Gaumukh, beyond Gangotri, are for those who seek solitude. This was not Mohan Kumar's goal, but being curious and believing in the merit of right effort, he agreed to come to Jumnotri.

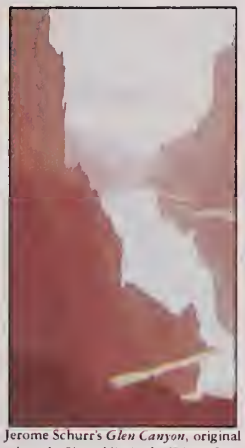
We had to return by bus and on foot to Rishikesh. There we hired a car and made our way as far as Hanuman Chatti—a day's walk from our destination—where we spent the night. Thirty years before, it had taken me four long days on foot to reach Hanuman Chatti. It is still just a tiny cluster of wooden buildings hanging on to a rocky ledge above the river, the pine-forested mountains rising almost sheer on all sides. The villagers continue to take in pilgrims, but now they offer thick, quilted bedding as well as drafty rooms. Before dawn the next morning, we set off on the narrow trail that leads up and up, with unpleasant stretches of path cut into the sheer rock face as much as a thousand feet above the river and with abrupt descents that are as alarming and exhausting as the ascents.

The last two or three miles are the worst, as though designed to test your faith. For me, with my fear of heights, the last cliff face traverse made me stop and consider, very seriously, just how much my life was worth. Halfway along the traverse, where the ledge follows the cliff around a jagged bend, the pilgrim sees for the first time one of nature's most magnificent shrines: the young torrent of water cascading down out of the snows and through the pine-covered gorge (crossed now by a wooden bridge that is more substantial than the old rope bridge that used to be there). On the near side of the bridge there is now a small rest house, a modern construction that seems quite out of place. Even more out of place was some colorful laundry hanging on a line, almost frozen stiff, and four figures in bright plastic slickers squatting on the ground at the entrance to the bridge, playing cards. They were European tourists on a three-week climbing holiday. In two days they had not crossed the bridge to the sacred shrine and hot springs on the far side. They did not even know that while the water on their side was icy cold, on the far side, fed by hot springs, it was warm enough to bathe in with comfort.

The plastic garments, the card game, and the visual pollution of the laundry, which I found so offensive, did not offend Kumar at all. His pilgrimage was not mine, his was public, not private. "They may think they are just on holiday, but if they enjoy climbing so much, why have they wasted two days here unless they are getting something else? Perhaps, for them, this side of the river is sacred." The tourists/climbers/pilgrims, as Kumar classified them, watched with amusement as we crossed the bridge and scrambled up to a cave above a small temple. Lal Bahadur, our driver, was not the least bit interested in the tourists; he was too busy smoking his last cigarette before he crossed to what he called the "good" side of the river.

I must have been a tourist thirty years earlier, for although I crossed the river then, I did not discover what the three of us discovered this time—each in his own way, each sharing his discovery. In the cave Mohan Kumar found the holy man of the cave and discovered that it was a sacred person rather than a site that he was seeking. We spent a long time in that cave. Lal Bahadur discovered

What your home could have in common with the Met, the Tate, and the Louvre



Jerome Schurr's *Glen Canyon*, original serigraph. Signed limited edition of 290.



Alexander Calder's *Jardin Fantastique*, original lithograph. Signed limited edition of 90.



Al Hirschfeld's *Charlie Chaplin 1*, original lithograph. Signed limited edition of 125.



Virgine Manzano's *Nude*, original lithograph. Signed limited edition of 350.



Cuca Romley's, *Central Park Fountain*, original etching. Signed limited edition of 170.



Wilbur Streech's *August Sun*, original serigraph. Signed limited edition of 250.



Marcelle Stoianavich's *Vacances*, original lithograph. Signed limited editinn of 225.

In your own home, you can exhibit original work by artists who are represented in the world's great musems and galleries.

Artists like Calder. Chagall. Dali. Miró. Picasso. Vasarely.

At the Original Print Collectors Group, we offer moderately priced limited edition prints by these and other well-known artists.

Our offerings include signed original etchings, engravings, and silk-screen prints.

Each print we offer is signed and numbered by the artist. Custom-framed. Accompanied by a certificate of authenticity and a full money-back guarantee.

And each print has been chosen not only for its beauty but for its investment value.

(Works by the artists we offer tend to appreciate, sometimes as much as 30% in a single year. Perhaps that's why *The Wall Street Journal, Business Week, Money,* AP, *Barron's* and UPI have quoted us as an authority on investing in art.)

For more information, send in the coupon. There's no obligation.

You'll find out about the special pleasure of owning original art, instead of just visiting it.



Suzanne Lemieux's *Summer Shadows*, original hand colored etching. Signed limited edition of 190.

Original print collectors group, Ltd.

215 LEXINGTON AVE., DEPT. NH-31, NEW YORK 10016

PLEASE SEND ME YOUR FREE COLOR CATALOGUE WITHOUT OBLIGATION.

NAME _____
PLEASE PRINT

ADDRESS _____

CITY _____ ST _____ ZIP _____



Fernando Torm's *Yellou Flouer*, original etching. Signed limited edition of 195.

© 1981 OPCG, LTD.



Share the Thrills of Exploring Outer Space!

$359.95 f.o.b. Hartford, Conn.

$15 Crating Charge

Now it's easy to join the thousands of serious amateurs who have discovered the excitement of exploring our mysterious universe. Your enjoyment begins right from the start, yet the challenges and rewards go on for years! And it's a hobby that can be shared at modest cost.

Choose From Many DYNASCOPES®

Picking a telescope to fit your needs and your pocketbook is simple when you select a DYNASCOPE — the same instruments used by more than 150 schools, colleges and observatories — and your satisfaction is guaranteed by a full-refund warranty.

FASCINATING GUIDE YOURS FREE!

Read these valuable facts before buying any telescope. Mail coupon or postcard for your complimentary copy of this helpful guide.



Criterion Manufacturing Co.
620 Oakwood Ave., W. Hartford, Conn. 06110

® TM Registered U.S. Pat. Office

CRITERION MANUFACTURING CO., Dept NH-105
620 Oakwood Avenue, W. Hartford, Conn. 06110
Please send your free Telescope Guide.

Name_____

Address_____

City_____ State_____



for Zoom & Telephoto Lenses

SLR CAMERA CASE

Patented

Special Safari Package

$39.95 $1.50 Regular postage & handling
$3.00 Air rush service
$2.00 Alaska & Hawaii

- Provides easy access to equipment
- Can be hung from a belt or shoulder strap
- Hi-impact polypropelene with thick foam padding provides solid protection against shock, rain, snow and dust. Yet it weighs less than one pound.
- Modular units unscrew to vary the case length
- Accommodates most SLR's with almost any lens between 16 mm-300mm (up to 3¼" Diameter) attached to the camera. (Will not accommodate Nikon Photomic metering or any auto winders).

Outside of Texas, for more information or to place order,

CALL TOLL FREE
1-800-231-1753
Use Master Charge or Visa

Safari Camera Case, Inc.
P.O. Box 19972 H
Houston, TX 77024
713-465-2232

Safari™

places where countless pilgrims had worn stones smooth as they worshiped. He discovered bells, outside the cave and inside the temple, and he rang them with exuberant joy. I discovered an unexpected natural shrine. Years before I had been enormously impressed by the hot springs that gush out of the rock, forming a little caldron in which potatoes and rice can be cooked in minutes; and I had been less impressed by the pools, lower down and less hot, in which pilgrims bathed. But I had not bathed; an Oxfordian prudishness has always made me nervous about nudity.

This time, however, while the food we had been given in the cave was cooking, Mohan Kumar said he was going to take a ritual bath, and from where we were, Lal Bahadur found that to get to the main temple, inconspicuously buried in the rock face, he had to go through a steaming pool. Suddenly I too was standing stark naked in the icy wind, and all three of us plunged into the hot water. We totally submerged ourselves, as much to unfreeze our noses as because it is ritually correct. When we came up for the third (ritually correct again) time, there was the disciple of the holy person of the cave, standing in the temple at the edge of the pool. With song and incense he was blessing us, blessing the water and the pine forests, blessing the whole world—including the card-playing tourists, I am certain. And there were the three of us, a Hindu Brahman, a Nepali Buddhist, and an Anglo-American agnostic, all equally naked and all equally blessed. The exhilaration was more than just the combination of altitude (about 11,000 feet), cold air, and a steaming-hot outdoor pool provided by nature. The nakedness had something to do with it, banishing the last illusion of distance and difference.

Mohan Kumar and Lal Bahadur did not come with me to Gangotri. The temples there had all been closed for the winter, and neither of them wanted to face the long walk beyond, to the face of the glacier from which the great Ganga pours, a place known as Gaumukh.

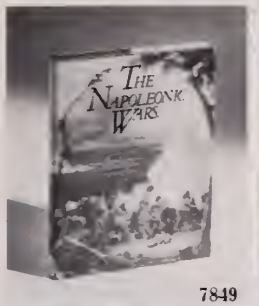
Gaumukh is probably the most inaccessible and the holiest of India's sacred natural places. The trail quickly climbs above the tree line. Suddenly, the massive snowy mountains that seem so remote when seen rearing up above the dark green pine forests are no longer remote; the snow is all around and there is nothing but rock and snow between you and the top of the world. The gorge, rising sharply, becomes an open, windy, shallow valley, with the river tumbling over rocks and boulders, the spray freezing as it lands.

The trail disappeared into a mass of enormous boulders, the size of two- and three-story houses, and the last mile took more than an hour of painful scrambling through the moraine, guided only by the sound of the river. Then, quite abruptly, the blue ice face of the glacier was right in front of me, and there was Gaumukh, the "mouth of the cow," a gaping black hole with stalactites and stalagmites of ice forming jagged teeth. Or was it, as some say, the head of the god Siva, the river pouring out of his tangled hair? In midstream a saffron flag had been erected on a pole wedged into the rocks. Having come this far, and too cold to be afraid, I made my way out. Reaching the rocks by the flagpole, I squatted down and dipped an enamel mug into the water, which if drunk at this place is said to give eternal life or release from it, whatever you choose to think. By the time I got the mug to my mouth the water had frozen inside it, and my fingers had frozen to the handle. A second dip, quicker this time, allowed me a couple of swallows, and the pilgrimage was over.

Except, of course, that it was not. Like tourists, pilgrims have to make their way home, be it from the crowded streets of a pilgrim resort such as Badrinath, from the cave of Bangali Baba at Jumnotri, or from the total solitude of Gaumukh where the rest of mankind has been left somewhere far below, far behind. And, also like the tourist, the pilgrim is not the same person that set out. For each there is a measure of transformation, intended and unintended. Something happens to both voyagers, largely to the extent that they are willing to let it happen, something that does more than rejuvenate, something deep and enduring. For each, one step further has been taken on the road to self-discovery, and the self is that much enlarged.

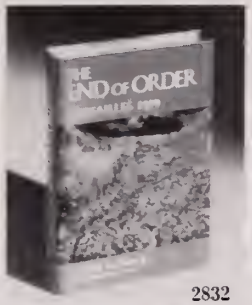
Colin Turnbull, formerly associate curator of African ethnology at the American Museum of Natural History, is visiting professor of anthropology at George Washington University.

23 engrossing books of history and world affairs...



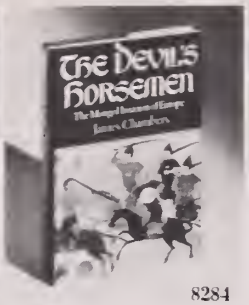
7849

The Napoleonic Wars: An Illustrated History 1792-1815. *By Michael Glover.* A vivid and masterful study. $22.50 **$12.95**



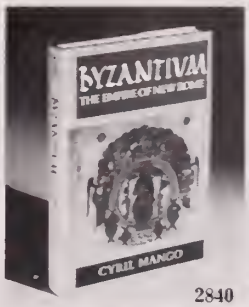
2832

The End of Order: Versailles 1919. *By Charles L. Mee, Jr.* Concentrates on the flamboyant personalities and nationalistic maneuverings which ended WWI, but set the stage for the turmoil to come. $15.95 **$10.95**



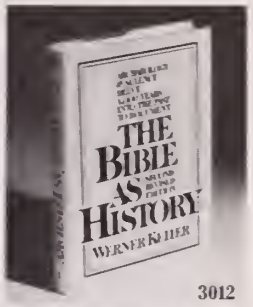
8284

The Devil's Horsemen: The Mongol Invasion of Europe. *By James Chambers.* The devastation of Eastern Europe and Russia during the 13th century. $11.95 **$8.95**



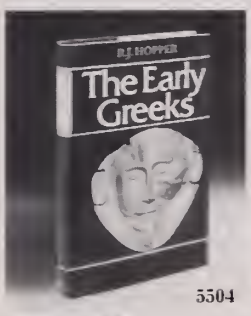
2840

Byzantium: The Empire of New Rome. *By Cyril Mango.* The centuries from 324 A.D. to 1453 are brought brilliantly to life in this view of Byzantium. $17.50 **$12.95**



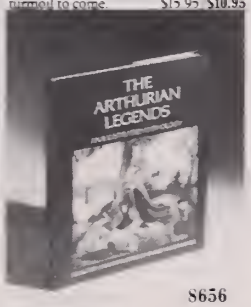
3012

The Bible as History. *By Werner Keller.* Archaeology and science delve 4,000 years into the past in an attempt to document whether the events in the Bible occurred as described. $14.95 **$10.95**



5504

The Early Greeks. *By R. J. Hopper.* The emergence of Greek civilization in all its archaelogical and cultural splendor $25.00 **$13.00**



8656

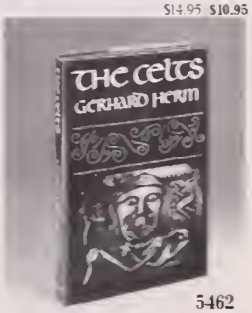
The Arthurian Legends: An Illustrated Anthology. *Selected and introduced by Richard Barber.* $19.50 **$13.95**

Take Any 3 All for 99¢

values up to $70.00

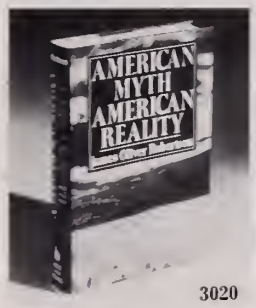
with trial membership

(First price is publisher's list. **Boldface** shows member's price.)



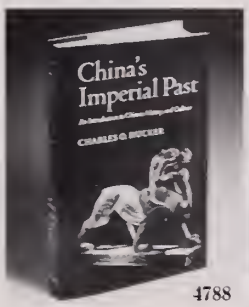
5462

The Celts: The People Who Came Out of the Darkness. *By Gerhard Herm.* A 2,000 year epic study of a powerful people and the remarkable civilization they built. $12.50 **$8.50**



3020

American Myth, American Reality. *By James Oliver Robertson.* An exploration of American myths as a reflection of our self-understanding. $16.95 **$11.95**



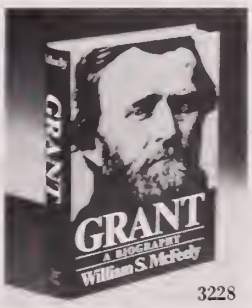
4788

China's Imperial Past: An Introduction to Chinese History and Culture. *By Charles O. Hucker.* $17.50 **$11.95**



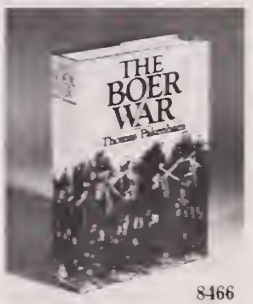
2790

Luther: An Experiment in Biography. *By H. G. Haile.* A questioning appraisal of the life and career of the mature Martin Luther. $14.95 **$10.50**



3228

Grant: A Biography. *By William S. McFeely.* Treats both the military and political careers. $19.95 **$12.95**



8466

The Boer War. *By Thomas Pakenham.* The romance of the late Victorian Empire and the last great imperial war. $20.00 **$12.50**

4 Good Reasons To Try The History Book Club

Big cash savings. Last year our members saved 33% on their Club purchases. Your total savings as a trial member, including this introductory offer, can be more than 50%.

Liberal bonus plan. You can qualify for added savings through bonus books, selected from our full list of 150-200 fine works.

Exceptional quality. In its 35 years, the Club has distributed over 1,000 books, including 81 award winners. Our books are the equal of publishers' editions, not economy reprints.

Membership Benefits. A membership account will be opened for you, to which your purchases will be charged at the low member's prices. You need pay only after you have received your books. A postage-and-packing fee is added to each shipment. Every four weeks (13 times a year) you will receive our *Review* containing descriptions of new and recent selections. If you want the Editors' Choice, do nothing; it will be sent automatically. If you want another book, or no book at all, return the card by the date specified. If you should receive an unwanted book because you had less than ten days to decide, you may return it and pay nothing. We guarantee postage.

More fine books to choose from:

First price is publisher's list. **Boldface** shows member's price.

3756. **Babylon.** *By Joan Oates.* $17.95 **$12.95**

8847. **Stonehenge and Its Mysteries.** *By Michael Balfour.* $14.95 **$9.90**

7583. **The Great Mutiny: India 1857.** *By Christopher Hibbert.* $15.95 **9.95**

2279. **Great Harry: The Extravagant Life of Henry VIII.** *By Carolly Erickson.* A vivid study of Henry's personal life. $14.95 **$10.50**

2170. **Lost Country Life.** *By Dorothy Hartley.* How English country folk lived, worked, threshed, thatched, rolled fleece, milled corn, brewed mead. $14.95 **$9.90**

2089. **A History of the World.** *By Hugh Thomas.* An unique perspective on history. $17.95 **$11.95**

2220. **Richmond Redeemed: The Seige at Petersburg.** *By Richard J. Sommers.* $22.50 **$13.95**

2956. **Germany: 1866-1945.** *By Gordon Craig.* $22.50 **$14.50**

8938. **The Gnostic Gospels.** *By Elaine Pagels.* Winner of the 1979 National Book Critics Circle Award for criticism, and the 1980 American Book Award. $10.00 **$8.50**

4648. **The Twelve Caesars.** *By Michael Grant.* A book of timeliness which examines the power, the successes, the failures and the hardships of being Caesar. $12.50 **$8.75**

P81C

The History Book Club

Stamford, Conn. 06904

Please enroll me as a trial member and send me the four books whose numbers I have entered below. Bill those on the left at 99¢ for all three and the fourth at the low member's price, plus postage-and-packing.

[ ] [ ] [ ] [ ]

I may return the books within three weeks at your expense and owe nothing. Or I will buy four more selections within a year (*not counting my choices above*). Membership is cancellable at any time thereafter. All Club purchases are at low member's prices and a postage-and-packing fee is added to all shipments. NH-54S

Print name_____

Address_____ Apt = _____

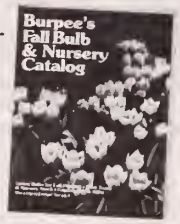
City_____

State_____ Zip_____

In Canada, mail to The History Book Club, Stamford, Conn. 06904

FREE–Burpee Fall Bulb and Nursery Catalog

—with dozens of Christmas and holiday gift ideas for gardeners.



Burpee's 1981 Fall Bulb and Nursery Catalog has 68 big colorful pages of: finest quality bulbs that produce large beautiful blooms—grapes—berries—fruit trees—flowering shrubs—trees—house plants—harvest and garden aids.

Send for your free Burpee Catalog today and get your entry form for Burpee's Fifth Garden Party Drawing. Grand Prize: Trip for 2 to the famous gardens of Holland and England—the kind of vacation that most gardeners dream about, and very few experience. Hundreds of other prizes. (No purchase necessary to win.)

For your free Burpee Catalog mail coupon below today. Burpee's Garden Party Drawing ends Dec. 31, 1981. Void where prohibited by law.

© Burpee Seed Co. 1981

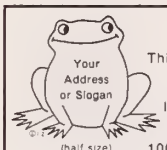
BURPEE SEED CO.
521 Burpee Building,
Warminster, PA 18974, Clinton, IA 52732
(Please mail to nearest address.)

Please send a free copy of Burpee's 1981 Fall Bulb and Nursery Catalog—including an entry form for Burpee's Garden Party Drawing to:

Name _____
(Please print)

Address _____

City _____ State _____ Zip _____



(half size)

FROG Stickers

This Happy Green Frog, printed with your name and address or slogan, adds a little fun to letters, books, luggage, toys, promotions....

Frog Shape...Self-Stick
100 for $6.50 or 200 for $9.20 ppd.

FROGS, Box 735-T. Acton, Mass. 01720

BOOK HUNTING?

Virtually any book located—no matter how old or long out-of-print. Fiction, nonfiction. All authors, subjects. Name the book—we'll find it! (Title alone is sufficient.) Inquire, please. Write: Dept. 71

**BOOKS-ON-FILE P.O. BOX 195
UNION CITY, NEW JERSEY 07087**

PERU
CUSCO — MACHU PICCHU
THE AMAZON

The largest variety of tour packages including First Class and Delux hotels, at the lowest price ever.

CALL NOW—TOLL FREE 1-800-223-1367
IN N.Y. CALL COLLECT (212) 582-7811
VALISHA TRAVEL
250 W. 57th. St.
N.Y.C. 10019

Seeing Double and Seeing Triple

The images of far distant single objects appear to be multiplied in accordance with a phenomenon predicted by Einstein

by Stephen P. Maran

During the past two years, astronomers have been studying two quasars: one that looks double in photographs and one that looks triple. But it turns out that these multiple photographic images are simply cosmic proofs that appearances can be deceiving. In each case, there is only one real quasar, and we are, in fact, "seeing double" and "seeing triple."

Quasars are the so-called quasi-stellar radio sources. They emit intense radio waves, as well as much visible and infrared light, X-rays, and gamma rays. A single quasar, although not much larger than the solar system, may be thousands of times brighter than a whole galaxy of hundreds of billions of stars. Thus, quasars are the most energetic class of objects in the universe. As a class, they are also the most distant objects known (see "Quasars Confirmed," *Natural History*, February 1980), and they are very rare. Despite extensive surveys, fewer than 2,000 quasars have been found, and these are typically separated from one another by tens of millions of light-years.

Given such large separations, it was remarkable when what appeared to be a double quasar was found, with its two members, 0957+561 A and 0957+561 B, separated by less than 6 seconds of arc (or 1/300 the apparent diameter of the moon). This corresponds to an actual separation between 0957+561 A and 0957+561 B of only about 220,000 light-years.

The discovery of the apparently double quasar was made on March 29, 1979, by Dennis Walsh, a radio astronomer at the University of Manchester, and two quasar experts, Robert F. Carswell of Cambridge University and Ray Weymann of the University of Arizona. With the 84-inch telescope at Kitt Peak National Observatory in Arizona, they found that the two members of the double quasar have similar spectra. The same absorption lines and emission lines are present with the same strengths in the two spectra, and the quasars have the same red shifts as well. Emission lines are bright spots in a spectrum caused by radiation from specific atomic elements; absorption lines are dark places resulting from atoms that cut off light at certain wavelengths. The similarity in spectral lines and red shifts between the two quasars meant A and B (as I shall call them) were at virtually the same distance from the earth and had similar chemical compositions and physical conditions.

The similar spectra led some astronomers to believe that a true binary quasar system had been found. In other words, they thought that A and B were in orbit around a common center of gravity, like the two members of a binary star, and that they must have been born together through whatever process it is that makes a quasar. This was my reaction as well, and it occurred to me that the uncanny similarity of A and B was evidence for the relatively unpublicized "spinar" theory of quasars. According to this theory, the energy of a quasar is derived from a very massive, rapidly rotating object, or spinar. If a spinar spun too fast, it might well split apart, perhaps producing two identical quasars. This argument may sound logi-

THE NEW FX-D QUARTZ FROM YASHICA

Superior Precision Made Affordable.



Total *Quartz* Control, instantly and accurately captures all lighting situations.



True Automatic/Manual operation with 100% precise *quartz* regulation offers beautiful results, frame after frame.



Automatic Dedicated Flash with exact *quartz* timing makes for perfect flash photography, day or night.



Automatic Exposure Lock quickly and confidently freezes the action with extreme *quartz* precision.



Auto Winder Capability with the accuracy of *quartz* assures once-in-a-lifetime results.



Perfect *Quartz* Precision in a sleek, compact 35mm SLR is now an affordable reality. In fact, the new *FX-D Quartz* from Yashica offers the versatility and total accuracy only available in cameras costing far more. And further, this ultra-precise *quartz* timing extends to its electronic accessories.

Created by the pioneer of both electronic and *quartz* photography, the unique *FX-D Quartz* is designed to be an integral part of the world's most accurate, totally adaptable 35mm system with more than 300 technically advanced accessories including the new CS-201 automatic dedicated flash, auto winder plus a host of sharp Yashica and Carl Zeiss T* lenses.

Find out more about the *FX-D Quartz* at your local Yashica dealer.

Yashica *Quartz*, Symbol of Precision and Quality.

YASHICA

411 Sette Drive, Paramus, N.J. 07652
In Canada: Yashica Canada, Inc., Ontario



"IN JUST 10 DAYS, I'LL SHOW YOU HOW TO DO

$\int_a^b f \sum_{n=1}^{x} a_n$ **REAL MATH**

ON YOUR SCIENTIFIC CALCULATOR!" ★

•Quick. •Easy. •Guaranteed. •Fun, too!

INTRIGUED BY CALCULATORS? Then you can step up your math skills *fast!* Use my *new method* in guidebook form. It's called *CALCULATOR CALCULUS* and comes with this guarantee: *If after 10 days you're not astounded at the problems you're solving on your own calculator, return the guidebook for an immediate refund.*

But the point is - you won't want to send it back. For this is the *easiest, fastest shortcut* ever! The day you receive your copy in the mail you'll want to put it to work. It's that exciting and helpful.

My name is Dr. George McCarty. I teach math at the University of California. I wrote this guidebook to cut through the confusion. It does just that — with worked-out examples, simple exercises and practical problems — all designed to work with precision and magic on your calculator!

POWER METHODS. Need to evaluate functions, areas, volumes — solve equations — use curves, trig, polar coordinates — find limits for sequences and series? It's all here!

If you're in the biological, social or physical sciences, you'll be doing Bessel functions, carbon dating, Gompertz growth curves, half-life, future value, marginal costs, motion, cooling, probability, pressure — and plenty more (even differential equations).

Important numerical techniques? Those algorithms are here, too-rational and Pade approximation, bracketing, continued fractions, Euler's method, Heun's method, iteration functions, Newton's method, predictor-corrector, successive substitutions, Simpson's method and synthetic division.

LOOK AT WHAT USERS SAY: Samuel C. McCluney, Jr., of Philadelphia writes: *"CALCULATOR CALCULUS IS GREAT! For ten years I have been trying to get the theory of calculus through my head, using home-study courses. It was not until I had your book that it became clear what the calculus was all about. Now I can go through the other books and see what they are trying to do. With your book and a calculator the whole idea becomes clear in a moment, and is a MOST REFRESHING EXPERIENCE. I program some of the iterative problems you suggest and it always GIVES ME A THRILL to see it start out with a wild guess and then approach the limit and stop.*

Professor John A Ball of Harvard College (author of the book *'Algorithms for RPN Calculators'*) writes: *"I wish I had had as good a calculus course.*

Professor H. I. Freedman of the U. of Alberta, writing in *Soc. Ind. Appl. Math Review*, states: *"There can be no question as to the usefulness of this book...lots of exercises...very clearly written and makes for easy reading."*

C.B. of Santa Barbara says: *"Your book has given me much instruction and pleasure. I do not hesitate to recommend it. 'CALCULATOR CALCULUS' is a book that inspires the reader to understand everything down to the last detail. You seem to have put your heart into the teaching."*

I WANT YOU TO TRY THIS. So, if you act now, you can invest in *'CALCULATOR CALCULUS'* for only U.S. $14.95 (to USA or foreign: add $1 for shipping, or $4 by AIR; in Calif. add 90¢ tax).

★ **GET MY COMPLETE KIT,** with a TI-35 calculator, a 200 p. Student Math Book, *AND* the guidebook, *ALL* for $39.95 (to USA only: add $2 for shipping, or $5 by AIR; in Calif. add $2.40 tax). As pennywise Ben Franklin said, *"An investment in knowledge pays the best dividends."* GET STARTED NOW — Tax deductible for professionals.

NO RISK WHATEVER! Send for it today. Be sure to give me your complete mailing address with your check or money order. If you want to charge it (Visa or MC), tell me your card no. and exp. date. *Prompt shipment guaranteed.*

Thank you!

George McCarty

EduCALC Publications, Dept. E-6
Box 974, Laguna Beach, California 92652
In California, call 714—497-3600;
elsewhere TOLL FREE 24-hour Credit Card orders:
800—854-0561, Ext. 845; Dept. E-6

TEAR OUT AND MAIL TODAY

cal, but fortunately I did not go on record with it. Further evidence soon showed that the hypothesis that A and B were physically distinct objects was wrong.

If A and B were indeed two distinct quasars, at two different points in space, then sufficiently powerful spectroscopic observations would inevitably reveal differences in certain absorption lines in their spectra. Unlike the emission lines, these absorptions are not produced by the gases of the quasars themselves, but in the intergalactic gas in their general vicinity. In particular, due to the motion of the intergalactic gas, the absorption lines in the spectrum of A should have red shifts slightly different from those in the spectrum of B.

Shortly after the March 29 discovery, however, additional spectra of higher quality were obtained with the 90-inch reflector of the Steward Observatory (another facility on Kitt Peak) and with the Multiple Mirror Telescope, an instrument equivalent in light-gathering power to a 176-inch reflector, on Mount Hopkins, also in Arizona. These spectra verified with greater precision that the absorption lines of A and B have identical red shifts. Walsh, Carswell, and Weymann were then able to conclude with high certainty that A and B are not two different quasars. Rather (as the three astronomers had suspected from the first, despite the skepticism of many colleagues), the double quasar represents the first known case of gravitational imaging, or gravitationally focused images, a phenomenon predicted by Albert Einstein as a consequence of his general theory of relativity. According to this interpretation, A and B are but two different images of a single real quasar. The images are formed by a natural gravitational lens, in this case a giant galaxy with strong gravitation, which focuses and intensifies the quasar light, just as a convex lens, or "burning glass," serves to focus the sun's rays to ignite a fire.

Einstein apparently did not consider the possibility that some object other than a star might act as a gravitational lens. But one of his contemporaries, the late Swiss astronomer Fritz Zwicky, realized that galaxies might also produce observable gravitational imaging and that the phenomenon could be used to increase the effective range of observatory telescopes. In 1937, Zwicky published a calculation

Come share Costa Rica. From the lively town fiestas to the peaceful atmosphere.





Now 50% more for your dollar.

Peaceful Costa Rica is truly a country of contrasts. You can spend your morning walking a secluded beach and experience the thrill of a town fiesta in the afternoon.

If you choose excitement, Costa Ricans always have a reason to celebrate. A Saint's Day, a town fiesta, a bullfight Costa Rican style, or a carnival.

On the other hand, if you would rather escape from the hurrying world, there are plenty of places to get away. Volcanoes. Waterfalls. A jungle train. Peaceful beaches. And you'll experience a gentle hospitality that's hard to find anywhere else.

Three nights accommodations and a city tour start as low as $56 (IT1LR1PF38) per person double occupancy, plus air fare. And with Costa Rica's favorable exchange rate, now you get 50% more for your dollar.

For more information on Costa Rica, call your travel agent or write: COSTA RICA TOURIST BOARD, Box #E11, 3709 N. W. 36th St., Miami, Florida 33142.

COSTA RICA

we have so much to share

WE'VE GOT THE SYSTEM THAT CAN MAKE YOUR PICTURES AS CREATIVE AS THESE.



It's the Cokin Creative Filter System. And it fits virtually every 35mm camera made, plus medium format, movie, TV cameras and enlargers. And almost all the lenses that go with them. From 36mm to 82mm filter diameters.

The key is an easy-to-use inexpensive filter holder. Each Cokin filter snaps in and out easily. You can even stack them for multiple special effects. There are more than 100 accessories to choose from, including color filters, prisms, masks and linear shutters.

The Cokin Creative Filter System. It'll make any picture you take like no picture you've ever taken before.



To see what Cokin filters can do and how easy they are to use, send a check or money order for one dollar, made payable to Minolta Corp. We'll send you a 40-page booklet with 158 full-color examples of Cokin filters in action. Mail to: Cokin Creative Filter System, Minolta Corp., P.O. Box 600, Garden City, N.Y. 11530

NAME (Please print)

ADDRESS

CITY STATE ZIP

(Please allow 4-6 weeks for delivery)

cokin

Creative Filter System

Marketed by Minolta Corporation

NH7

©1981 Minolta Corporation

showing that the focusing of light from a distant galaxy by a closer one would intensify the former's brightness by a factor of as much as 100. He pointed out that if astronomers could find such gravitational images, they would be able to explore the universe to much greater distances than otherwise possible, since very distant galaxies (which ordinarily would be too faint to be seen) would be intensified to the point of observability.

Despite Zwicky's "farsighted" suggestion, no clear case of gravitational imaging of one galaxy by another has ever turned up. Astronomers have, however, found another way to explore the universe beyond the distance of the faintest detectable galaxies: they discovered quasars. As I mentioned earlier, quasars are much brighter than galaxies and hence are detectable at greater distances. In fact, shortly after the first quasars were found in 1963, it was suggested that they were *all* gravitationally focused images. Specifically, it was proposed that quasars are not a unique type of cosmic object but rather gravitational images of the central cores of very distant galaxies. The suggestion did not pan out and, in fact, was never taken very seriously by most astronomers.

When Walsh, Carswell, and Weymann reported that they had found a pair of gravitational images, many astronomers remained skeptical. "Where is the lens?" they wanted to know. Existing photographs such as those from the Palomar Sky Survey did not show a foreground galaxy between A and B, nor did photographs taken specifically for this purpose in Arizona after the March discovery. The Walsh team expected that the lens galaxy would be midway between A and B, as seen from the earth, because the two quasar images are of nearly equal brightness.

It was not until November 1979 that astronomers at the California Institute of Technology and at the University of Hawaii succeeded in obtaining telescopic photographs good enough to reveal the missing lens. Sensitive electronic cameras made this possible. Surprisingly, the lens is not midway between A and B, but rather just slightly north of the southern quasar image, B. The lens is a very large elliptical galaxy, a member of a cluster of galaxies located less than halfway from the earth to the real quasar. As the light from the quasar travels toward the earth, it is deflected and

focused by the gravitational field of the lens galaxy, and it is also affected by the gravitation of the galaxy cluster as a whole. Because the lens is not a simple spherical object, not the perfectly shaped work of an optician but a real galaxy of stars, the light bending is more complex than the simple mathematical case that Walsh, Carswell, and Weymann had considered. Also, the B image is actually seen through the lens. These two circumstances account for the fact that the A and B images are not equally spaced around the lens galaxy.

During the year following the discovery of the double quasar, many radio observations were made of it. The most impressive results, however, were obtained in January and February of 1980, by means of a technique known as Very Long Baseline Interferometry (VLBI). In VLBI a celestial radio source is observed simultaneously with antennae at widely separated locations on the earth. The received signals at each antenna are recorded on magnetic tape, along with very precise timing information from an atomic clock. Then the tapes from the various observatories are collected and analyzed by computer. The net result is a measurement of the size and structure of the radio source, with a precision comparable to that which a single radio telescope could provide only if its diameter were comparable to the transcontinental spacing between the VLBI antennae.

The VLBI measurements of the double quasar were obtained with antennae in Germany, Sweden, the United Kingdom, and West Virginia. They showed that the two images, A and B, are not simply little round dots in the sky. Instead, each consists of a tiny bright core with an elongated jet extending to the northeast. Thus, the two apparent members of the double quasar are virtual carbon copies of each other, maintaining a precise resemblance even when scrutinized with the most powerful technique at the astronomer's command.

About a year after the double quasar was discovered, a second case of gravitational imaging was found. The team leader in this case was Weymann. Although by that time a number of astronomers were on the lookout for additional examples of gravitational imaging with galaxies and quasars, the second discovery was purely accidental. Weymann and several other observers were conducting routine studies of quasar spectra. While observing the fairly well-known quasar PG1115+08, Weymann noticed that during a moment of exceptionally good viewing, the blurry image on the TV monitor of the 90-inch Steward Observatory telescope suddenly resolved into three components. One member of this triple quasar is much brighter than the other two, and all three are within three arc seconds of one another, making them even more closely spaced than the two images of the double quasar. Once again, however, subsequent studies with the Multiple Mirror Telescope showed that the three apparent quasars have identical spectra and red shifts, indicating that this is indeed another sport of nature: three gravitational images of a single quasar to befuddle astronomers who have difficulty enough in accounting for the remarkable properties of even a single garden variety quasar.

Stephen P. Maran is a senior staff scientist in the Laboratory for Astronomy and Solar Physics at NASA's Goddard Space Flight Center in Greenbelt, Maryland.



TWA's Getaway® Middle East.
Wonders from the past. Memories for the future.

This year, take in the myriad wonders of the Middle East—the exotic Nile, the fabled Aegean, the mystical Holylands.

This year, take a Middle Eastern vacation with TWA Getaway.



As America's most comprehensive tour program to the Middle East, TWA Getaway offers 9 quality vacations combining the finest modern accommodations and services. Ranging in price from only $668 to $2258.*

For your free TWA 1981 Getaway Middle East brochure, call your travel agent or TWA. Or use the coupon below. After all, there's no time like the present to discover the wonders of the past.

Please send me TWA's 1981 Getaway® Middle East brochure. L

Mail this coupon to: TRANS WORLD AIRLINES, P.O. Box 930, Madison Square Station, New York, N.Y. 10010

Name_____

Address_____

City_____ State_____ Zip_____

You're going to like us TWA

NAX-7

*Per person, based on double occupancy, exclusive of air fare.

ONLY IN THE ORVIS CATALOG · ONLY IN THE ORVIS CATALOG · ONLY IN THE ORVIS CATALOG · ONLY IN THE ORVIS CATALOG · ONLY IN THE ORVIS CATALOG · ONLY IN THE ORVIS CATALOG ·



WORLD'S COOLEST SHIRT

Popular Indian Madras 4 Colors

Another of the many distinctive family clothing items, gifts, home accessories and decorator accents you'll find *only* in the new, Free, full-color Orvis Catalog. Send now for this very special book that will fit your lifestyle and brighten your days



SEND TODAY FOR YOUR FREE COLOR CATALOG

Name _____

Address _____

City _____

State _____ Zip _____

THE ORVIS COMPANY
125 Years of Sporting Tradition
161 River Road, Manchester, VT 05254

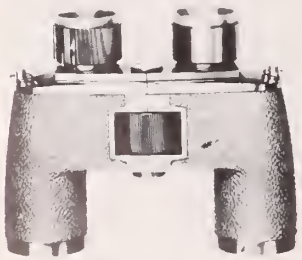
ONLY IN THE ORVIS CATALOG



Treasures From The Earth

Color Portfolio of Natural Specimens and Catalog of Minerals, Display Stands, Books and Natural Jewelry, $3.00

Dover Scientific
Box 6011C Long Island City, NY 11106



BUSHNELL 7x35 CUSTOM
Mfg. List $280.00 Postpaid $164.00

This is an example of the deep discount prices on high quality optics that is found in our FREE catalog. This catalog lists and illustrates an outstanding selection of telescopes, binoculars etc., plus valuable information on how to properly select them. Write for it today.

GIL HEBARD OPTICS
COURTHOUSE SQ., KNOXVILLE, ILL. 61448

Plant Parenthood

Before dispersing, most flowering-plant embryos become dormant. Are mother plants protecting themselves from hungry young?

by Robert E. Cook

The sight of an animal and its young evokes deep feelings in many of us, yet we seldom respond to plants in quite the same way. A mother plant clucking over her clutch of growing seeds is difficult to imagine. But in an evolutionary sense the provisioning of progeny is very similar in plants and animals: all mothers will partition nourishment and protection among their offspring in order to leave as many descendants as possible. At some point in the development of their offspring, all mothers must also negotiate the delicate process of weaning.

In 1966 the British evolutionary biologist William D. Hamilton suggested that the evolutionary interests of the developing embryo are not necessarily the same as the mother's. The mother's genetic future is best served by maximizing the number of her offspring that survive as successful plants in the next generation. Each offspring contains the same proportion of her genes. Therefore, she should distribute her resources evenly among her seeds so that each receives sufficient nutrition to provide an excellent chance of successful seedling establishment. Too much food in any one seed might diminish the prospects of all the others. Each offspring, however, may have a different interest. Because pollen is promiscuous, each embryo may have a different father. It will try to maximize its own success, regardless of the fate of its kin, by increasing its share of maternal sustenance at the expense of other offspring and the mother. The resolution of this conflict of interest between mother and child is known as weaning; in plants, this process is intimately bound up in the development of the seed.

Seeds are genetically complex and are not simply rudimentary plants waiting for an appropriate moment to germinate. Each seed does contain an embryonic individual, which acquired half its genes from the mother when she formed an egg and half from a grain of pollen. This embryo is analogous to an animal embryo, but a seed is more than a fetal plant. Surrounding the embryo is a genetically distinct tissue, called endosperm, that serves as the source of nutrition for the embryo. Endosperm, for example, forms much of the starchy pulp of corn kernels and the liquid milk of coconuts. Like the embryo, endosperm tissue is neither exclusively maternal nor exclusively paternal in origin. Unlike the embryo, however, it develops from the fusion of one pollen nucleus with two or more maternal nuclei. Genetically, it has at least twice as many maternal genes as paternal genes; in some species up to fourteen maternal nuclei fuse with one set of paternal genes to form the endosperm. Therefore, this tissue genetically approaches, but is not identical with, the maternal tissue that surrounds it during development. Finally, to guard its contents through the journey of dispersal, every seed also has a seed coat, a hard covering composed of several layers of outer tissue. Seed coats, as well as the fleshy fruits, pods, and hard shells of many species, develop from the maternal tissue of the flower; their particular qualities depend entirely upon the action of maternal genes.

If these genetically complex seeds were produced asexually, each offspring would be identical to its mother and sibs, and there would be no conflict of interest. In sexual reproduction involving different individuals, however, half the genes of each embryo arrive with the pollen and represent the evolutionary future of some other plant. A pollen grain contributes little energy to the raising of offspring; most nutrition is maternal. By being parasitic on the nutritional largess of the female, the paternal genes achieve equal genetic representation in the embryo while catching a cheap trip into the future. Under the influence of their paternal genes, individual embryos may demand more food than the mother is prepared to provide. The resolution of this conflict lies in the intricacies of seed development.

Traditionally, seed development has

been interpreted as a single, integrated process marked by cooperation between parent and offspring. A grain of pollen alights on the tip of a flower and begins to grow slowly down the stalk. Once the pollen reaches the ovary, its two male nuclei, each with half the genes of the father, enter the embryo sac and seek fusion with maternal nuclei. The rapid cell division that results from the union of one paternal nucleus with two or more maternal nuclei produces endosperm tissue, which is fed by the proliferating vascular structure of the adjacent ovular wall. The other paternal nucleus fuses with another maternal nucleus to create a zygote, or fertilized egg cell, which gradually commences growth. After numerous cell divisions, this embryo has developed two growing tips and one or two incipient leaflike cotyledons for the storage of nutrients. Rather than coming directly from the mother, much of the energy for the growing offspring comes at the expense of the endosperm. This tissue may be rapidly expanding close to the vascular supply while being digested by the embryo a short distance away. (In some species, such as beans and peas, the offspring eventually consumes all of the endosperm and occupies most of the future seed.) Gradually, the growth of the seed begins to slow down, the water content drops, and the outer coat hardens. According to this traditional view, the future seedling becomes dormant in preparation for dispersal; germination will occur later upon rehydration of the seed.

But is a phase of dormancy really necessary for proper seedling development? Ian Sussex, a developmental biologist at Yale University, and his students have suggested an alternative interpretation of seed development, which suggests that the roles of the mother and the offspring are somewhat in conflict. They see the formation of a new individual—from a fertilized egg to a growing, rooted shoot—as a potentially continuous de-

Rocky Mountain High



Purcell Range — British Columbia

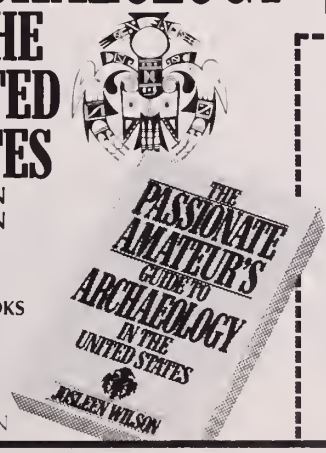
Superlative autumn scenery. Mountains, fjords, glaciers and waterfalls. Countless rivers and coastal streams. Totem poles overseeing all, from hidden places. Come on up.

Canada
SO MUCH TO GO FOR

Write us at: Tourism British Columbia, 1117 Wharf St., Victoria, B.C. V8W 2Z2. Or see a Travel Agent.

THE PASSIONATE AMATEUR'S GUIDE TO ARCHAEOLOGY IN THE UNITED STATES
JOSLEEN WILSON

COLLIER BOOKS
A division of Macmillan Publishing Co., Inc.
MACMILLAN



Take a different kind of vacation—into America's past!

With this wonderfully rich paperback guide, you can go on a dig... visit excavations... see special museum collections... join other interested amateurs who tour regularly.

All of the information you need to enjoy such fascinating adventures is assembled in one concise volume that's written so engagingly, even armchair adventurers will find it delightful.

State-by-state coverage of sites and museums, travel directions, admission-fee data, hours, photos, maps, charts—all of it is here, to help you explore the extraordinary legacy of America's past.

THE PASSIONATE AMATEUR'S GUIDE TO ARCHAEOLOGY IN THE UNITED STATES

Enclosed please find $_____ for _____ copy(ies) @ $12.95 each, plus $1.50 for each book for postage and handling. I understand that if I am not completely satisfied, I may return my purchase within 15 days for a full refund.

Name _____
Address _____
City _____
State _____ Zip _____

098670-X/IC#093

Mail to:
COLLIER BOOKS, Macmillan Publishing Co., Inc. 100K Brown Street, Riverside, NJ 08370 NH

Please add appropriate state and local taxes.

velopmental pathway of cell division and tissue differentiation. In most higher plants, however, the mother imposes a detour on the offspring that channels it out of growth and into a phase of dormancy and desiccation. There it must await a signal to resume growth. Germination, then, represents a return to the original developmental pathway.

Sussex divides embryogenesis—the formation of the embryo within the seed—into two phases. Initially there is a period of intense cell division, with relatively little increase in size, as the fundamental structure of the future plant is roughed out. During this time, endosperm tissue grows rapidly on maternal resources and surrounds the offspring. The second phase commences suddenly about halfway through embryogenesis. The water content of the embryo begins to fall. Cell division ceases completely, and the embryonic body proper stops development. The offspring starts to digest the endosperm, and its cotyledons, now rapidly expanding, begin to store the newly formed proteins and starch. Finally, the seed coat dries and hardens into a constraining, impermeable jacket. The imprisoned embryo must survive on its own reserves until released by hydration.

Germination reverses this process. The seed absorbs water rapidly, expanding its cells and cracking the encasing coat. The rudimentary root penetrates the gap, and cell division accelerates throughout the body of the embryo. The remaining food stores in the cotyledons begin to disintegrate and pass to the growing tips. Incipient leaves soon form, shedding the maternal covering and expanding into the light.

Does the mother plant really impose developmental arrest on her young during embryogenesis, as this view suggests? Sussex calls upon three kinds of evidence to sustain his interpretation. First, there are viviparous species, whose seeds germinate while still attached to the mother plant. The growing embryos of coastal mangroves, for instance, never enter the dormant phase of seed formation, germinating well before they drop into the tide to root in local mudflats.

A second kind of evidence comes from the biology of primitive vascular plants, which may roughly resemble the ancestors of modern seed plants. Like mangroves, the embryos of ferns do not require dormancy for successful development. Their entire reproductive biology, however, is interestingly different: ferns reproduce by spores rather than by seeds and the offspring does not actually grow on the body of the mother plant. Instead, a spore, carrying half the mother's genes, disperses on the wind and begins to grow some distance from the original stalk. Slowly, a rudimentary, heart-shaped plantlet forms. This plantlet may engage in an intimate nutritional association with an underground fungus or develop a green disk of photosynthesizing cells. When moisture becomes abundant, the plantlet forms an egg nucleus that also has half the mother's genes. An identical process leads to the production of sperm, or gametes. For fertilization to occur, these male gametes must swim through a surface film of water to a nearby plantlet. Sex is thus obligately associated with a wet habitat. The embryo commences cell division, differentiates leaves and roots, and completely crushes the small plantlet in the process of growth. Neither desiccation nor dormancy has any necessary part in this pattern of plant formation. The seed habit may have

The Soligor 80-200mm Expand Your Horizons By Getting Close.



You've got a terrific 35mm SLR camera, but not all of your shots are terrific. Some suffer from too much unwanted scenery, some from tiny people in big frames... shots that didn't work because your creative I.Q. was more than your *lens* could handle.

That's right, lens. But, Soligor has a solution: the affordable, innovative Soligor 80-200mm One-Touch Zoom + Macro lens that lets you and your camera turn blah into beauty.

Zoom in to crop out extraneous details. Bring your subjects up to 4 times closer than a standard lens can. Frame your shots exactly as you want them, and Soligor quality captures them faithfully. Create exciting portraits, instead of just pictures of people; capture a still life or sports action as the kind of picture you bought your camera to get; experiment with amazing close-ups, thanks to macro ability. And it's all so easy with Soligor's single One-Touch control for zoom, focus and macro.

If some of the zip has gone out of your picture taking, zip down to your Soligor dealer and try our 80-200mm on your Canon, Minolta, Pentax, Olympus, Nikon or other fine camera. Or, write for full information.

SOLIGOR®
MAKES THE DIFFERENCE

AIC Photo, Inc. Carle Place, N.Y. 11514
In Canada Kingsway Film Equipment, Ltd. Ontario

evolved from primitive plants with a reproductive biology much like this.

The most compelling evidence for Sussex's thesis, however, comes from the artificial culture of embryos. If a developing seed is carefully dissected under sterile conditions, its embryo can be surgically lifted out from the surrounding endosperm and maternal tissue. Removed from the influence of the mother, the embryo ceases storing proteins and starch in the cotyledons. When placed in the proper nutrient medium, it will suddenly begin to grow and form a plant with roots and leaves. This has been called precocious germination, and it can occur at any time during the second phase of seed maturation. This second phase—with its cessation of cell division in the embryo, rapid storage of proteins, and subsequent developmental arrest—is apparently a response to the influence of the maternal environment.

Closer inspection has revealed the agent of this maternal control. Sussex and his students monitored the flux of plant hormones in the developing embryo of the French bean seed. High concentrations of hormones known to stimulate cell division and expansion characterize early ontogeny; these are the same hormones found in the growing plant after germination. At the critical transition point in the middle of embryogenesis, a new and quite different hormone, called abscissic acid, appears and rapidly increases in concentration. This substance is known to inhibit certain kinds of biochemical processes and is often associated with drought-stressed plant tissue. The concentration of this hormone soon reaches a peak as the cotyledons become congested with nutrients and the embryo undergoes dehydration. Finally, the seed coat hardens, and the concentration gradually drops to a low level.

Some scientists believe that the abscissic acid is synthesized in the maternal tissue and transported to the embryo through the endosperm. Sussex, however, feels that the abscissic acid may be created by the embryo itself in response to a more fundamental signal from the mother, such as a gradual withholding of water. In either case, the certification of this hormone's role comes again from artificial culture. If an excised embryo is bathed in a nutrient medium supplemented with abscissic acid, precocious germination fails to occur. The

Folk Art



Saint-Jean-Port-Joli Québec

You will marvel at the variety and beauty of the art objects lovingly carved from the living wood by the local artists. Each piece a joy to own. Each one unique. Like Canada in autumn.

Canada
SO MUCH TO GO FOR

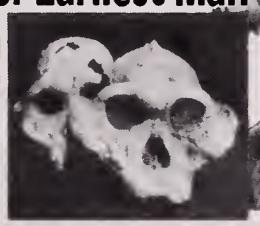
For more details write us at Tourisme Québec, C P 20 000, Québec (Qué.) G1K 7X2 Or see a Travel Agent

The "Evolutionary War" explained

As *National Geographic* photojournalist John Reader surveys the century-old search for earliest man, he sheds light on the current rivalry between the world's pre-eminent paleontologists, Donald Johanson, of "Lucy" fame, and the Leakey family.

"Riveting and unsettling....No one has laid out the conflicting theories of human origins or exposed their weaknesses more comprehensively than Reader."
—*Publishers Weekly*

MISSING LINKS
The Hunt for Earliest Man
John Reader





With 58 superb color prints, $19.95
A SCIENCE BOOK CLUB SELECTION

Little, Brown
34 Beacon St.
Boston, Mass. 02106

cotyledons proceed to swell, storing nutrients at a rate proportional to the concentration of abscissic acid, and the embryo becomes metabolically quiescent. The maternal influence has been simulated.

Abscissic acid, then, appears to be the chemical mediator of the developmental arrest imposed by the mother. It signals the impending desiccation of the offspring and initiates preparation for survival. It is a harbinger of stress, and it will serve a related function in the shoots of the adult. We know that its concentration increases in the leaves of drought-stressed individuals as the effects of declining water are felt. Ordinarily, water moves from the soil into the roots and through the vascular system of the plant to the surface of leaves, where it evaporates through small apertures called stomata. This liquid flow flushes each plant cell and provides the pressure that gives rigidity to stems and leaves. If soil moisture begins to decline at the roots, the lowered flow of tissue fluid leads to wilting leaves. At these times of declining water, however, the concentration of abscissic acid in the vicinity of the stomata increases, causing the surrounding cells to expand and close off the escape of fluid. With its internal pressure held constant, the plant can remain turgid while awaiting the relief of drought.

How remarkable that the embryo should respond in its own style to this messenger of stress. Yet this is nicely coincident with recent thinking on the origin of the flowering plants, in which embryo dormancy has undergone its most elaborate evolution. The great evolutionary biologist G. Ledyard Stebbins believes that the earliest flowering plants probably appeared more than 160 million years ago. Their origin is usually assumed to have been in the humid tropics, where there is often little seasonal variation in climate. Stebbins, however, argues that subtropical montane habitats, subject to seasonal drought, are a more likely cradle for flowering-plant evolution. Seasonality would greatly constrict the period of time permitting reproduction and would expose embryonic offspring to unfavorable conditions of drought. To survive, the embryo would require protection from imminent desiccation. Would not any individual able to respond to maternal signals of drought stress be more likely to survive to the next generation? The embryo's ability to store food and become dormant did indeed prove highly adaptive. This capacity also provided the mother plant with an incipient mechanism to control her growing young, which may have become essential for her own survival.

Indulge me, for a moment, in a bit of historical speculation on the evolution of the seed habit in the ancestors of modern flowering plants. Ferns, you may recall, are totally dependent upon free-flowing water for sexual reproduction. The male sperm must *swim* to the female egg that has formed in the small, rudimentary plantlet produced by a spore from the mother shoot. Such a system could not survive in conditions of even minimal drought; the plantlet alone would shrivel and die. The fertilization of the egg within maternal tissue solved this problem. Rather than releasing spores to the wind, the mother plant retained this stage within her own body, protecting it from desiccation. As a result, any seasonal declines in moisture no longer restricted reproduction.

But bringing the developing embryo into the safety of the maternal environment was not without its com-

WHETHER RAIN, FOG, OR SUDDEN SQUALL...
Swift Waterproof Binoculars Shine Through.

When weather conditions are less than perfect, see your way clear with Swift quality waterproof binoculars.

Seafarers are always prepared with Swift's **753 Sea Hawk Mark I** (7x, 50 I.F.–393 ft.–36 oz.), **717 Storm King Mark II** (7x, 50 I.F.–383 ft.–52.2 oz.), or the **717A Armored Storm King Mark II** (7x, 50 I.F.–383 ft.–53.6 oz.) aboard. All these fine binoculars feature a high relative light efficiency of 84.2, producing razor sharp images even during that unpredictable storm-at-sea.

Sports fans and ornithologists can enjoy the action even under the most adverse conditions when "armed" with Swift's quality waterproof glasses. The **752 Falcon Mark I** (7x, 35 I.F.) delivers a particularly wide field of view (525 ft.) and close focusing to 18 feet. Swift's **820 Armored Trilyte Mark III** (9x, 35 I.F.) offers maximum hand-held power in a compact (26 oz.) wide-field (383 ft.) instrument.

Swift also has an extensive selection of rugged waterproof riflescopes. So put on your rain slicker and enjoy the sights... with Swift's high performance waterproof instruments.

SWIFT®



For More Information: **SWIFT INSTRUMENTS, INC.** 952 Dorchester Ave., Boston, MA 02125 or P.O. Box 562, San Jose, CA 95106

plications. Previously, the offspring's voracious appetite was confined to the consumption of the egg-forming plantlet, which lived independently of maternal nutrition. With the embryo growing in the mother's body, what was to prevent digestive incursions into maternal tissue while still permitting protection and measured sustenance?

I suggest that in the flowering plants, the solution was a "trust fund" established by the mother. The evolution of a nutritional intermediary, the endosperm, provided a zone of neutrality between the rich vascular supply of the mother and the omnivorous proclivities of the embryo. With this interposed tissue, the offspring never feeds directly on the mother's vascular supply. The extent of endosperm formation defines the nutrition of the embryo. The mother's final measure of control lies in the imposition of dormancy through the agency of abscissic acid. This hormone precisely regulates the digestion of endosperm and the storage of proteins and starch in the cotyledons, insuring that the funds of the mother's trust are properly spent in preparation for dispersal. With the water content of the seed dropping, the embryo desiccates and the surrounding seed coat hardens. Weaning is complete.

To heighten the narrative line of my essay, I have cast the characters of this evolutionary drama in stark roles of conflict and employed a script filled with a language of intent and purpose. In contrasting the interests of mother and young, I have implied that the embryo gained no advantage from the development of maternal control over nutrition and dormancy. The evolution of the modern seed was undoubtedly more complicated than this. For one thing, every successful offspring must become a parent itself. If it possessed paternal genes that caused it to feed too greedily as a child, the plant would eventually face similar demands from those of its progeny that inherited the genes. Perhaps this explains the evolutionary resolution of the conflict in favor of maternal control over nutrition and dormancy. We may never know. As always with evolutionary speculation about the past, we are forced to reconstruct history from its diminishing echo.

Robert E. Cook is associate professor of biology at Harvard University.

Mist That Thunders



Niagara Falls Ontario

Niagara. The very name evokes romance. Ride the 'Maid of the Mist'. Feel the earth shake beneath you, feel the spray like a tropical rain. Try a second honeymoon, this autumn.

Canada
SO MUCH TO GO FOR

For information, call us collect (416) 965-4008. Or see a Travel Agent

for every lover of Americana . . . a Collector's Treasure for the entire family

World Famous McGUFFEY'S READERS

seven books that shaped a nation

Not just the primer—but the full set from primer through sixth grade . . . faithfully reproduced from the original engravings! Here are the books our great-grandparents used in that one-room schoolhouse. No fancy theories, no newfangled nonsense, no educational experiments—McGuffey's Readers mean business! (Could be that's why kids learned their 3 R's in those days!) Yes, first published in 1871, these books were the backbone of *Readin', Ritin',* and *Rithmetic!*

A fabulous acquisition for the serious collector. A joy for the whole family. Grandparents, Mom, Dad, kids . . . *everyone* will love a nostalgic look at this less complicated time, the gentle charm of the illustrations, the old fashioned simplicity of the texts. Truly a cherished gift.

McGuffey's Readers (Z621730)
Complete Set of All 7 Books
ONLY $24.95

YOUR UNCONDITIONAL GUARANTEE
Our merchandise is unconditionally guaranteed to please you in every way or your purchase price refunded—no questions asked!

New Hampton General Store
340 Poplar St., Hanover, PA 17331



dozens of illustrations from original engravings

New Hampton General Store, Dept. BZ-8065
340 Poplar St., Hanover, PA 17331

Please send _____ Set(s) of All 7 McGuffey's Readers (Z621730) @ **$24.95** per set plus $2.25 postage and handling on FULL MONEY BACK GUARANTEE.
☐ **GIFT SAVINGS!** Order Two (2) Sets (one for yourself, one as an unforgettable gift), just **$45.00** plus $4.00 postage and handling.
Enclosed is $_____ (PA residents add sales tax)
CHARGE IT:
☐ American Express ☐ Diners Club
☐ VISA/BankAmericard ☐ Carte Blanche
☐ Master Charge Interbank No. _____
Acc't. No._____ Exp. Date_____
PRINT NAME_____
ADDRESS_____
CITY_____ STATE_____ ZIP_____
☐ Check here and send 50¢ for year's subscription to our full-color catalog of fine gifts, (Z618314X). We ship within forty-eight hours; delays notified promptly. Delivery guaranteed within sixty days.

© New Hampton General Store 1981

The stalked eyes of this mantis shrimp from the Gulf of California (Hemisquilla ensigera californiensis) *provide it with excellent vision. This large species lives in burrows it excavates in the sandy bottom.*



The Hole Shrimp Story

A burrow in the sand or a hole in coral is of paramount importance to mantis shrimps

by Marjorie L. Reaka



Alex Kerstitch

It had been an exhilarating dive, eighty feet below the surface of Cane Bay, Saint Croix. My husband, Steve, several graduate students, and I had been diving in the bay to study the growth forms of deep-dwelling corals and the animals that live in and under them. We had seen gorgonian corals that looked like pipe cleaners, huge, platelike corals that drooped over the precipices, and multicolored fishes. The water was dark blue as we drifted over the coral-encrusted cliff, which drops 200 feet to the floor of the bay.

Upon our return to the West Indies Laboratory (which is affiliated with Fairleigh Dickinson University), we were told by Charles Seaborn, a professional underwater photographer, about an exciting find—a large sand-dwelling mantis shrimp had been observed in a burrow in a nearby bay. Although I had been studying the behavior and ecology of tropical mantis shrimps for ten years, I had never seen this rare species of *Lysiosquilla* in its burrow. Charles, Steve, and I immediately dashed off, our old Fiat rattling in protest, to observe and photograph the creature—a member of a lineage that diverged from other major groups of Crustacea about 400 million years ago.

The ancient Crustacea developed into a number of modern lineages, including the Stomatopoda (mantis shrimps), Isopoda (pill bugs or sow bugs), Amphipoda (beach hoppers), and Decapoda (true shrimps, lobsters, and crabs). The isopods and amphipods have eight pairs of walking legs. In decapods, these appendages have differentiated into five pairs of walking legs and three pairs of anterior mouthparts, or maxillipeds. The first or second walking legs of many decapods are modified into pinchers; in crabs, one first leg is dramatically enlarged as a claw, which is used to crush and scrape food, in complex displays, and in actual combat over shelter or a mate.

Stomatopods diverged from ancient crustacean stock earlier (in the



Charles R. Seaborn



Devonian) than these other lineages and have retained a different body organization, with only three pairs of walking legs and five pairs of anterior maxillipeds. Stomatopods also possess a primitive neural organization, with three pairs of ganglia, or groups of nerve cells, arranged in a row above the mouth. In contrast, in decapods, isopods, and amphipods, these groups of neurons are condensed into a compact "brain." In spite of the primitive arrangement of their ganglia, however, the stomatopods have strong learning abilities, highly active predatory habits, and a complex fighting behavior that is at least as sophisticated as that of the decapods.

The second pair of maxillipeds in stomatopods is modified into a pair of claws. Each claw, when open, exposes a series of teeth or a toothless blade with a needle-sharp tip, depending on the family to which a particular species belongs. In families where the claws bear serrated teeth, individuals use the appendages for snatching and holding soft-bodied prey such as polychaete worms and fishes. Mantis shrimps with snatching claws excavate burrows in mud or sand and attain larger sizes than those with bladelike claws. In families that have bladelike claws, the base of the last segment of the claw is swollen and heavily calcified. This type of claw is used as a hammer to smash hard-bodied prey such as snails, clams, rock oysters, and other crustaceans. Mantis shrimps with hammering, bladelike claws live in holes in coral or rocks and are restricted in their body size by the size of the available holes. These species are often more aggressive, more heavily armored, and more brightly colored than the species with snatching claws, which live in soft substrates.

The predatory, or raptorial, strike of the bladelike claws—almost too quick for the eye to see—bears a strong resemblance to that of the terrestrial praying mantis. This similarity is responsible for the common name of stomatopods, mantis shrimps. Although praying mantises and mantis shrimps evolved independently, on land and in the sea, their claw structure, their habit of waiting concealed to ambush unsuspecting prey, their stalked, mobile eyes and visually mediated behavior, and even their three pairs of walking legs are remarkably similar. Moreover, on the inside of each of their raptorial appendages, mantis shrimps, like some praying mantises, bear a colored spot, which they expose in threat displays. The mantis shrimps could well be considered the marine equivalent of the terrestrial praying mantises (or vice versa).

Mantis shrimps are found in all tropical and subtropical marine waters, but never in fresh water. Although one species is known from depths of more than 3,500 feet, most species live in shallow habitats less than 100 feet deep. Considered a delicacy in many cultures, the shrimps represent an important fishing industry in the Mediterranean, and their claws are prized as fishhooks in many areas of Oceania. Their bellicose nature, as well as their delectability, has earned mantis shrimps additional names in many languages. They are called "split toe" or "split thumb" in the West Indies, "pica" in Mexico and Central America, "shako" in Japan (where they are common in fish markets), and "vako" in the Gilbert Islands.

The mantis shrimps' claws are used not only for catching food but also for defense, as any diver who has placed a finger near the entrance to

This eight-inch-long mantis shrimp, left, and the author engaged in a gentle tug of war over some tidbits of squid. The mock battle took place in the waters off Saint Croix; the author never quite succeeded in luring this rare species, Lysiosquilla glabriuscula, *completely out of its burrow, below left. Iridescent color spots on the posterior appendages (uropods) of* Hemisquilla ensigera californienses, *below, can be used to startle potential predators.*

Alex Kerstitch



one of their burrows can testify. I have more than once retracted my hand from an unsuspected coralline domicile with the point of a mantis shrimp claw embedded in my finger—and with the fierce defender, less than two inches long, dangling from my hand. Divers are said to have had their fingers cut or even sliced off by individuals of a large species of mantis shrimp (up to ten inches in length) that occupies burrows in muddy substrates off southern California and Mexico.

Other notable characteristics of these ancient marine creatures are their bright coloration and elaborate fighting behavior, particularly in coral-dwelling species. Oval flaps protruding from anterior and posterior appendages (antennal scales and uropods, respectively) are often iridescent blue, red, or yellow and fringed with conspicuously colored hairs (setae). Body segments are often edged in brilliant red, and background body coloration may vary from chartreuse, emerald, carmine, speckled brown, orange brown, or lemon yellow to black with yellow stripes—even among individuals of the same species. In some species, particularly those in less aggressive families, all individuals are similarly colored. The function of different body colors among individuals of a species is not known, but such variation may allow longtime neighbors to recognize each other and hence avoid fights, may confuse predators, or both.

All mantis shrimps have an indentation on the inside of each raptorial claw. In the most aggressive species, this indentation is marked with a brilliantly hued "eyespot," which can be orange, vermilion, royal purple, powder blue, yellow, rose pink, or magenta. In other species, especially those belonging to less aggressive families, the spots are pale green or white. While body coloration varies considerably among individuals of some species, the color of the eyespot on the claws is identical on all individuals within a particular species.

In one of their most conspicuous threat displays, mantis shrimps lower and spread their claws, exposing the eyespots; at the same time the other, smaller maxillipeds (usually yellow, but sometimes white or iridescent blue white) are spread wide, and the head is reared back, with the antennae and antennal scales extended to the side. This display, used with interlopers, potential predators, and prospective mates, serves both to suddenly show the eyespots and to increase the apparent size of the shrimp.

Many organisms, including butterflies and fishes, are also known to startle predators by suddenly exposing conspicuous eyespots on some part of their body. The spots on the claws of the mantis shrimps, however, serve more than one function. The unvarying color of these spots within a particular species suggests that they convey information on species identity. Several species of mantis shrimps with similar morphologies often live in the same local habitat. The most aggressive species bear the brightest-colored spots. It is advantageous for members of an aggressive species to have some identifying, warning characteristic so that members of subordinate species can recognize and avoid them; thus the dominant shrimp is required to engage in fewer potentially damaging fights. The subordinate shrimp also benefits from recognizing the spots of the dominant species, as it can avoid a fight it would probably lose. Furthermore, members of subordinate species benefit from being less colorful because brightly colored spots could elicit an attack from a member of a dominant species.

In addition to the eyespot display, mantis shrimps direct aggressive behavior against other stomatopods that is remarkable for its rapidity and intensity. The shrimps smash opponents with the armored bases of the claws and spear them with the opened blades. These animals fight to the death in some cases, and individuals bearing characteristic wounds are frequently collected in the field. Most of the blows are not lethal, however, because each opponent rolls up into a ball, thrusting its armored tail toward the other like a shield. The opponents' blows frequently strike each other's shields, but rarely cause damage. Each of the coiled shrimps threatens and strikes over its shield, and

Polychaete worms, such as Hermodice carunculata, *right, share the same coralline habitats as mantis shrimps. Crabs of the family Majidae, below, are common prey for mantis shrimps living in coral reef rubble and back reef habitats.*

Charles R Seaborn



the two whirl and trade blows at a breathtaking pace. In the accounts of such fights that I tape-recorded as part of my research, I frequently sound like a sportscaster. As a pair of fighting mantis shrimps performed as many as 500 different aggressive acts during a ten-minute bout, student friends rooted for favorite warriors.

Extreme aggression creates social problems for the mantis shrimps. Like all crustaceans, they must shed their hard outer skeleton in order to grow. During the molting period, the shrimps are immobilized, soft, and thus vulnerable to predators, particularly other mantis shrimps. In fact, cannibalism of newly molted shrimps is common if the molted individuals have no refuge. Nevertheless, mantis shrimps have developed a variety of adaptations that decrease the dangers associated with molting, including sealing their burrow entrances with pebbles; a reduced period of incapacitation compared to other, less aggressive crustaceans; molting late at night when other mantis shrimps are inactive; and synchronous molting (in association with lunar cycles).

Their aggressive behavior also imposes a solitary existence upon mantis shrimps, except for a brief mating period when males and females manage to live together. Males apparently probe various burrows until they find a female sufficiently receptive to permit their entrance. Courtship is an elaborate affair, replete with threat displays that involve exposing the species-identifying eyespots. Aggressive acts, such as lunges and strikes, and defensive coiled stances gradually diminish as the pair become conditioned to each other by courtship displays and body contact in which the two glide past each other in the burrow, their sides touching. Before mating, the male massages the female's back. During copulation, he constantly scratches her anterior thorax with a small, brushlike first maxilliped. Courtship and mating continue in the burrow for several days until overt aggression reappears; eventually, the female evicts the male from the burrow.

In the next few days the female lays a batch of eggs (ranging from fewer than a hundred eggs in some small species up to many thousand in large species); then for more than a month she will abstain from food while she carries the compact mass in her maxillipeds. By constantly kneading and cleaning her brood, the female protects the developing embryos from microorganisms that would foul and kill them if she abandoned the egg mass for more than a few hours. The small larvae hatch and remain with the female in her burrow for several days to a week before they emerge and swim away. Like many other tiny organisms subject to predation by plankton-eating fishes, the transparent, spiny mantis shrimp larvae migrate to the surface to feed when the fishes are less active, just after sunset and before dawn; during the day the larvae hide near the substrate. The larvae bear raptorial spearing claws, and prey on other, smaller nocturnal plankton.

The evolution of the intense aggressive behavior of mantis shrimps has been linked to their occupation of burrows. Most fighting occurs in and around burrows, suggesting that they are a critically important and limited resource; when the shrimps venture forth from their protective burrows they are subject to predation by fishes. As might be expected, then, those species of mantis shrimps that inhabit preformed holes in dead coral or rocks are more aggressive than species that dig burrows in mud or sand and need not depend on an existing supply. Larger holes in coral are less common than smaller ones, and larger individuals within stomatopod species have also been observed to be more aggressive than smaller individuals. Similarly, among related coral-dwelling species of mantis shrimps, larger species are often more aggressive (and have brighter-colored spots) than smaller species.

Mantis shrimps that dig burrows must spend considerable time and effort in excavating, all the while exposing themselves to predators. Thus, these burrows are costly and, like preformed ones, worth defending. As a result, even shrimps that live in excavated burrows in soft substrates are considerably aggressive, although ag-

NATURAL HISTORY MAGAZINE

NEW SUBSCRIPTIONS OR RENEWALS

SAVINGS CERTIFICATE

FOR THE SUM OF 9 DOLLARS

For _____

This Subscription Savings Certificate represents a saving of $9.00 off the single-copy newsstand rate for a full year (12 issues) of NATURAL HISTORY magazine, and includes membership in the American Museum of Natural History as well.

☐ **YES!** Please send me a full year of NATURAL HISTORY for the low rate of $15 for twelve issues, and my membership card.

☐ I want to save more. Send me two years of membership and 24 issues (two years) of NATURAL HISTORY for only $26 (a $22 savings off the newsstand rate).

☐ I want to save even more. Send me three years of membership and 36 issues (three years) of NATURAL HISTORY for only $35 (a $37 savings off the newsstand rate).

☐ Payment enclosed ☐ Bill me later **Send gift to:**

Name _____ (please print) Name _____ (please print)

Address _____ Address _____

City _____ City _____

State _____ Zip _____ State _____ Zip _____

☐ New ☐ Renewal ☐ 1 year $15 ☐ 2 years $26 ☐ 3 years $35

Outside of U.S. and Canada, add $3 per year. Please allow approximately 7 weeks for delivery of first issue.

J474

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO. 30 BERGENFIELD, NJ

POSTAGE WILL BE PAID BY ADDRESSEE

NATURAL HISTORY

P.O. Box 4200
Bergenfield, N.J. 07621



Charles R Seaborn

gressive behavior and associated skeletal armature are much more developed in shrimps limited by nonexpandable holes in coral or rock.

The giant mantis shrimp discovered by Charles and his friends was a *Lysiosquilla glabriuscula*. The species in the genus *Lysiosquilla* include some of the largest known stomatopods, attaining sizes of up to fifteen inches. Characterized by toothed claws and broad black-and-white or black-and-yellow bands across the body, these species are rare, and little is known of their habits other than that they dig vertical burrows in sandy substrates.

The discovery of this large *Lysiosquilla* was intriguing since we had been studying one of the smallest species of sand-dwelling mantis shrimps, *Nannosquilla schmitti*, in a nearby bay. Adults of the latter species are white and only about three-fourths of an inch long. When placed on a fine, sandy substrate, one of these petite shrimps will begin digging with its pleopods—abdominal flaps that beat rapidly, propelling a cloud of sand behind the animal. As a depression is formed, the shrimp arches the middle of its back downward; then it dips the anterior part of its body into the depression, gathers a load of sand in its maxillipeds, and flings the particles away, thereby enlarging the hole. This action is repeated until only the tip of the animal's tail clings to the rim of the burrow while its long, thin body hangs head-first down into the hole. Turning sinuous somersaults inside the burrow (which is scarcely wider than its body), the shrimp continues to gather sand, then emerges head-first at the surface, and flings the sand onto the small mound accumulating outside the entrance. Often the shrimp hesitates, peering in various directions with its mobile stalked eyes, which rotate independently as it surveys the surroundings, then somersaults again into the narrow burrow. The large *Lysiosquilla* had presumably excavated its burrow in the sandy bottom of the bay in a similar manner.

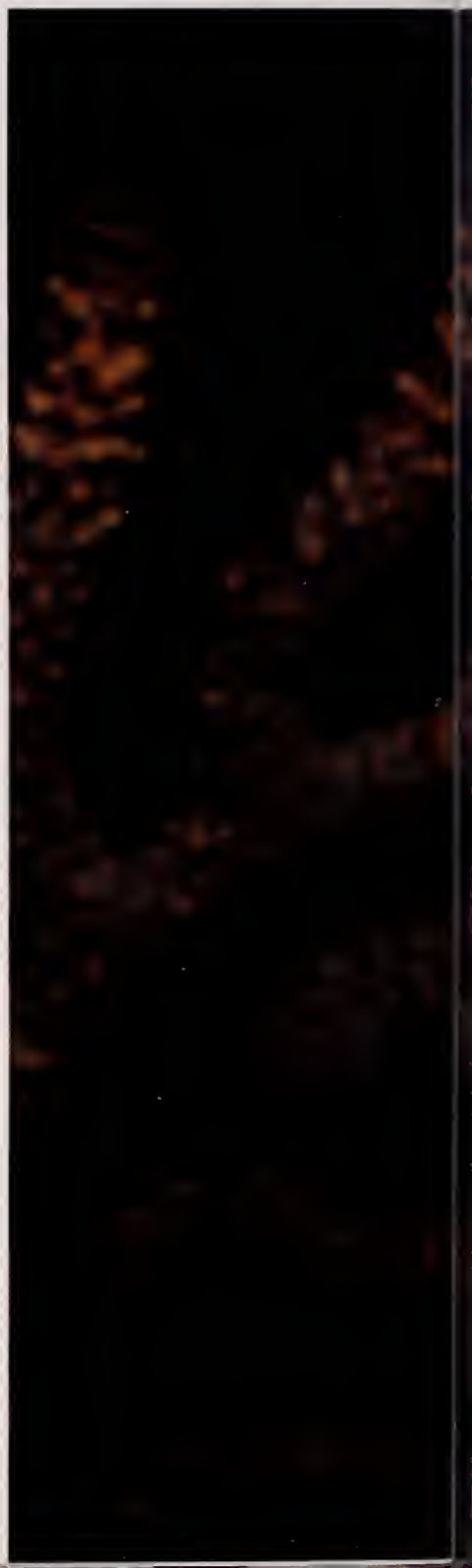
Recent studies conducted by Raymond Manning of the Smithsonian Institution and myself have shown that lineages of small stomatopods evolve more rapidly than lineages of large stomatopods. A few closely related species of *Lysiosquilla* are found in all the world's oceans, suggesting an old and slowly evolving group. *Nannosquilla*, however, is found only in the Americas, and all fourteen small species of this lineage have diverged into distinct species in either the east Pacific or west Atlantic regions since the elevation of the Central American land bridge about three million years ago. We found that these trends in evolution held up in all groups of stomatopods.

I thought about this varied evolutionary history as I lay on the sandy bottom of the bay peering at the iridescent yellowish green eyes, rudder-like antennal scales, and folded raptorial appendages of an eight-inch-long mantis shrimp. It returned my stare, rotating first one eye, then the other, appearing unconcerned in its two-inch-wide burrow. Charles had been directed to the shrimp by friends who were living on a sailboat in the area. Keen observers of the organisms living around them, they had watched the shrimp as it cleaned its burrow and performed its daily routines. As already suggested, mantis shrimps learn rapidly, and this individual had quickly become accustomed to its observers. Our friends had supplied us with some pieces of squid, and reassured by the serene appearance of the shrimp watching me, I extended my hand and the piece of squid toward

Charles R. Seaborn



The claws and anterior appendages of this Lysiosquilla glabriuscula *are spread wide in a threat display. Appearing larger than it really is because of the display, the shrimp is backing away from the author and descending into its burrow.*



it. Like a flower unfolding, the shrimp raised its black-and-white barred body and moved toward my hand, spreading its raptorial appendages in a threat display, and then extended the delicately brushed maxillipeds, reaching, grasping, sensing the meat. It caught the edge of the squid and pulled with surprising strength toward its burrow. We engaged in a tug of war, the shrimp attempting to sequester the delectable meal in the depths of its burrow, while I tried to entice it to leave its burrow so that we could see its entire body. I never totally succeeded, as the shrimp always clung to the edge of the burrow with its tail. Eventually, it pulled the piece of slippery squid from my hand and slid out of view in the burrow. I looked at Charles in dismay, afraid that we would get no more photographs of the marvelous animal.

After its meal, however, the shrimp reemerged to peer at us. I offered another slice of squid, and this time I was determined to retain it. After considerable tugging, the shrimp investigated my hand, gently enfolding it within the raptorial claw. The shrimp tapped, touched, tasted, and gently stroked my entire hand with the dainty maxillipeds, then returned to its tactic of tugging at the bit of meat, pulling this way and that, until it again retreated into its burrow. Once inside the shrimp resumed peering at me, its two large eyes rotating until it emerged for another attempt. We engaged in this contest over the squid appetizer for more than an hour. Never did the shrimp strike a blow to my hand with its powerful raptorial appendages. Once, forgetting caution for a moment, I reached out with my other hand to touch the animal as it leaned far out of its burrow for the shred of squid. Without haste, it slipped smoothly beneath my hand and back into the burrow. I soon overcame my chagrin, however, for the shrimp reemerged, seemingly undaunted, to seek more squid.

When we finally left the giant mantis shrimp, only its yellow eyes protruded from the burrow. The shrimp had retained its independence to the end, never having left the security of some contact with the burrow; it had endured with equanimity the intrusion of large, glass-faced, bubbling monsters and had taken our token offerings of squid. We left, elated by our good fortune at having shared an afternoon with such a magnificent, solitary creature. □

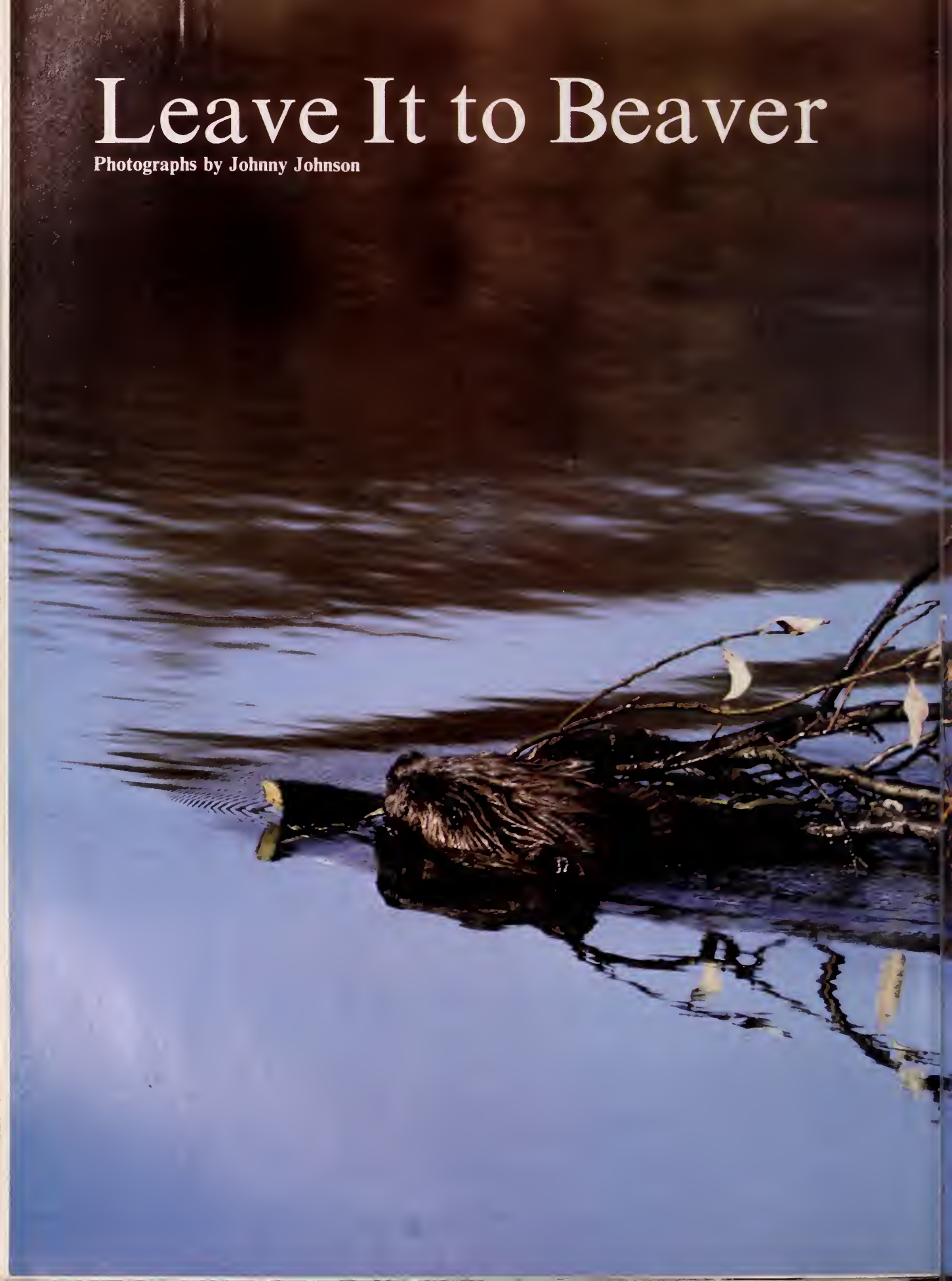
Squilla tiburonensis *uses its spearing claws to snatch soft-bodied prey. It inhabits the coastal waters off the province of Sonora, Mexico.*

Alex Kerstitch



Leave It to Beaver

Photographs by Johnny Johnson









Winter comes early to Mount McKinley National Park in Alaska. By September, when these photographs were taken, light snowfalls occasionally dust the countryside, and the vegetation has assumed the colors of autumn. In a few weeks, blasts of frigid Arctic winds will sweep the landscape, locking the area's plant and animal life in cold storage.

Beavers have evolved a variety of techniques for coping with the difficulties and dangers imposed by a long winter. In particular, by constructing dams, lodges, and canals and storing food, these animals are able to deal admirably with hard winter conditions. Dams, usually built to blockade streams, create the ponds that are necessary as refuges from predators, conduits to float food and building materials, and sites to store food for use in the winter.

In preparation for the coming winter, this beaver is transporting willow branches to a cache in the pond. The branches will be anchored to the bottom, where they will stay until needed by the hungry rodent. Passing the winter in the security of its lodge, the beaver simply swims under water to the nearby cache and consumes enough willow bark to satisfy its needs. Then it's back to the lodge and its insulated environment, safe from howling winds, subzero temperatures, and prowling predators. It is this scenario that, in a couple of months, will be replayed across the frozen reaches of the North.



Dodge Omni Euro-Sedan

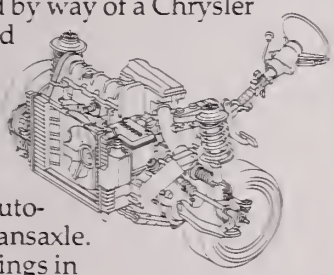


Dodge Omni Euro-Sedan: The power of a Chrysler engineered Trans-4 engine brings a new level of performance to America's first small front-wheel-drive automobile.

After years of research and development, the engineers at Chrysler introduced the advanced technology of front-wheel-drive to a small American built car. The Dodge Omni. That was 1978. Since then, more than 19 billion miles of owner experience with a full line of front-wheel-drive cars has been logged. Now the performance capabilities of a Chrysler built 2.2 liter Trans-4 engine creates a sporty new breed Omni. The front-wheel-drive Dodge Omni Euro-Sedan.

2.2 liter Trans-4 engineered for economy and efficiency.

Over half a century of experience designing and building some of the finest engines in the world went into the all-new Chrysler built Trans-4 engine. 135 cubic inches of displacement in a car that weighs under 2200 pounds puts a lot of power at your disposal. Designed specifically for front-wheel-drive, the engine is transversely mounted between the front driving wheels. The power of the Trans-4 gets to the road by way of a Chrysler designed 4-speed manual as well as a new 3-speed automatic transaxle. The savings in weight contributes to its impressive fuel economy.



41 est. hwy. 25 EPA est. mpg.* Fuel efficiency enhanced by advanced computer technology.

Chrysler's Electronic Fuel Control System means the Omni Euro-Sedan has an engine with a "brain." 7 sensors monitor engine functions, continuously adjusting the timing of spark plug firings and the air to fuel ratio. At all times, this electronic brain is making split-second decisions, while you drive, for the most efficient operation of Omni Euro-Sedan at all times, with minimum fuel consumption.

So easy to service, you can do it yourself.

You'll appreciate Omni Euro-Sedan's ease of servicing. Most major service parts on the Euro-Sedan's engine—oil filter, distributor, plugs, even fluid reservoirs—are right up front and easy to reach.

Omni Euro-Sedan represents the quality Americans demand.

Omni Euro-Sedan, like all new front-wheel-drive Chrysler built cars, is built in one of the most technologically advanced plants in the world. Computers keep a watchful eye during the assembly process. Robots perform most of the welding on the body and chassis to insure durability. Electronic consoles monitor 37 different functions of the engine with 66 tests. What's more, before the car can leave the line, it must go through and pass more than 2000 quality checks.

Dodge Omni Euro-Sedan only $6722**

Omni Euro-Sedan's base sticker price includes its 2.2 liter OHC engine, black bumpers and sill moldings. Cast aluminum road wheels. Sport steering wheel. Sport high back bucket seats.† Rallye Instrument Cluster that includes tachometer and electric clock. Black remote control mirrors.



Dodge Omni Miser. $5499 50 est. hwy., 30 EPA est. mpg.***

You might consider the Dodge Omni Miser. The lowest priced, highest mileage automobile built by Chrysler. Yet Omni Miser has an appreciable level of standard equipment which includes a specially calibrated 1.7 liter OHC engine and 4-speed manual transaxle. Rack and pinion steering. And front disc brakes.

Dodge

The New Chrysler Corporation

*Use EPA est. mpg for comparison. Your actual mileage may vary depending on speed, weather and trip length. Actual highway mileage will probably be lower. **Sticker price excluding title, taxes and destination charges. WSW $61 extra.
†Optional low back bucket seats as shown $43 extra. Buy or lease at your Dodge dealer.

The Origin of High Andean Birds

Biogeographers attempting to explain the complex history of birds living in the high Andes of South America must be part scientist, part detective

by François Vuilleumier

Breathtakingly beautiful at times, with a palette of bright colors under the hot, midday sun, but forbidding at others, with strong winds, hailstorms, persistent fogs, and the numbing cold of early morning, the high-altitude realms of the Andes continue to draw me back. Since 1964 I have made six expeditions, totaling about twenty months, that have taken me all along the Andean backbone, from Venezuela to northern Patagonia. Why? Because the Andes are, as ornithologist Frank M. Chapman put it half a century ago, "A New World."

Geologically recent, this narrow, 4,000-mile-long mountain chain provides the biogeographer with a wonderful setup for inquiries about fundamental evolutionary problems. The paramos of the Venezuelan and Colombian Andes—wet, grassy alpine-like areas extending from 10,500 feet up to the snowline—are islands of open vegetation separated from each other by lower-altitude cloud forest. Farther south, in Peru and Bolivia, the high-altitude zone, known as *puna*, broadens into an arid and sparsely vegetated plateau stretching to the horizon. Not surprisingly, paramo and *puna* habitats have little in common with the steaming lowland or the cool montane forests found in other parts of South America. But they also share little with the hot, grassy savannas of Venezuela or the open shrublands of Brazil. The high Andes are more like the Patagonian steppes at the far south of the continent.

The resemblance between habitats of the high Andes and Patagonia applies to the bird fauna as well. An ornithologist familiar with Patagonian birds who was transported 1,500 miles north to the Bolivian high plateau would feel at home. The two areas share a number of genera and several species; even the missing families are the same. How, then, did the high Andean birds evolve? Do they derive from Patagonia or do Patagonian birds derive from the high Andes? How much of the fauna is the result of

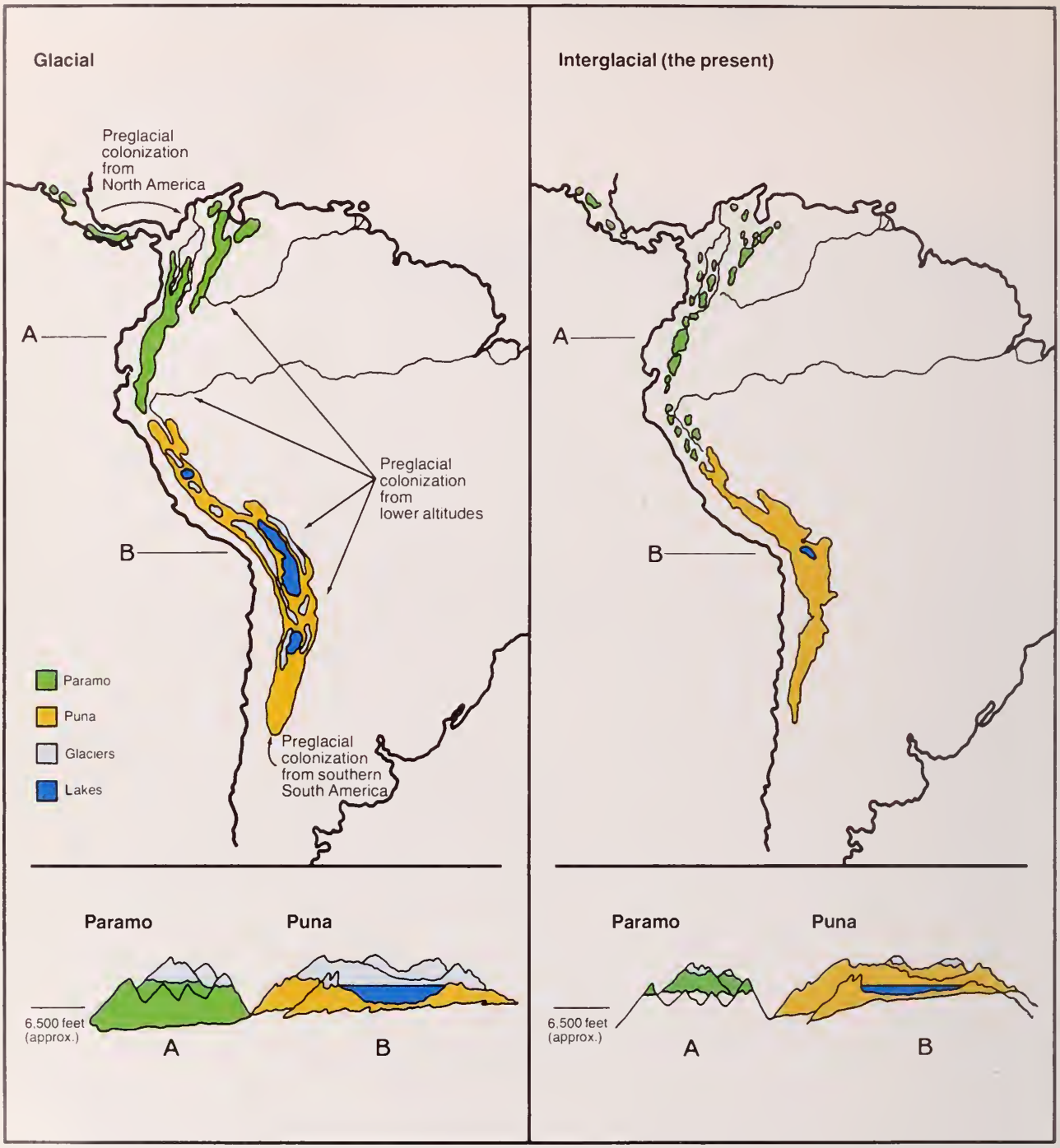


David Ewert

Glacially carved valleys intersect at 13,550 feet in the desert paramo of the Venezuelan Andes. At such high altitudes, arborescent espeletias (relatives of the dandelion) dominate the landscape, growing up to eight feet tall in the frost-softened soil.



PLEISTOCENE DISTRIBUTION OF PARAMO AND PUNA IN SOUTH AMERICA



Prior to glacial times, birds colonized the high Andes via several routes. The distributions of these birds altered as the vegetation types fluctuated during the glacial–interglacial cycles. In glacial times (left), paramo and puna *vegetation were more extensive and reached lower altitudes than in interglacial times, such as the present (right). Some new bird species arose as a result of isolation of paramo and* puna.

speciation in the high Andes themselves and how much the result of immigration from lowland areas?

These questions boil down to a classic problem in biogeography; in this case, how to explain the history of about 180 species of birds. The procedure is a bit like detective work: look at the evidence, omit no detail, and reconstruct the circumstances of the crime. The crime was committed in only one way, but the circumstances can almost always be variously reconstructed, depending on the interpretation of certain crucial details. Similarly, although the fauna of a region evolved in only one way, different scientists working with the same biogeographical evidence may well suggest dissimilar reconstructions of that evolution.

We need two kinds of clues: historical ones—ideally, abundant fossil remains—and modern ones, revealed in the distribution patterns of living species. Fossils of high Andean birds

are so scarce that they are virtually useless. Biogeographers are, however, beginning to learn about the history of some Andean environments through the work of palynologists, who study pollen, and about the history of the mountains themselves through the efforts of geologists.

In the Andes today, permanent glaciers are found only at the highest altitudes, but in the past they extended much farther down the mountainsides. In several areas of Venezuela, Colombia, and Peru, moraines and fluvioglacial accumulations of rocks and other materials attest to between one and three major glacial advances. But if the Andes, like parts of Europe and North America, witnessed four major advances, why are they not all recorded? One view is that at the time of the earliest glacial advances in the Northern Hemisphere, the Andes were not sufficiently high to have had glaciers. The high, alpinelike environments of the Andes (the wet paramos of Venezuela, Colombia, and Ecuador and the drier *puna* of Peru, Bolivia, northern Argentina, and northern Chile) probably only date from the mid- to late-Pleistocene era, one to two million years ago.

While not definitive, pollen data also suggest that the Andes have been high for a geologically short time. Palynologists have carried out several detailed studies of cores taken from ancient bogs in the Andes of Venezuela, Colombia, and Bolivia. They have dated the peat from different core depths and counted and identified by species the pollen grains found in the peat. The resultant "pollen profiles" indicate how much pollen was contributed by different species of trees or grasses at different times and different places. For example, at one locality in the Colombian Andes, currently at an altitude of 13,500 feet and situated fully within the paramo zone, the vegetation apparently changed repeatedly during the last 15,000 to 20,000 years. At times, woodlands occurred at the site, while in other periods the vegetation resembled the wet grassland that now dominates the area. The overall picture of the Andes is one of vegetation zones that have been alternately lower and higher over about the past 100,000 years. During cold, glacial episodes, alpinelike vegetation reached much lower altitudes than it does now. By contrast, at the peak of warmer, interglacial episodes, the zones moved up, so that the paramo and *puna* region was even more restricted to mountaintops than today.

If a given bird species now found exclusively in alpinelike grassland had the same habitat requirements in the past, its distribution would have changed over time according to the periodic contractions and expansions of its environment. Theoretically, this "cycle" of habitat disruption could have led to the formation of new species, and not surprisingly, different subspecies or, indeed, species of birds do sometimes occur on mountaintops that are now geographically isolated from one another. In other cases, differentiated taxa are found in close geographical contact; careful study of these contact zones has revealed hybridization in some instances and slight range overlaps without hybridization in others.

We have here a model for speciation, and hence faunal buildup, from within the system. The bearded helmetcrest (*Oxypogon guerinii*), for example, is a small hummingbird inhabiting the high altitudes of four isolated Andean regions: three in Colombia (in the Santa Marta Mountains, the eastern Andes, and the central Andes) and one in Venezuela. Because the birds in each of the four allopatric, or geographically isolated, populations are morphologically differentiated, ornithologists once treated them as species; they are now considered subspecies. A possible sequence of events leading to this pattern is not hard to imagine. During a glacial period, a formerly widespread ancestor may have lived all along the central and eastern Andes and extended north into Venezuela and the Santa Marta Mountains. At this time, the paramo zone, in which the ancestral helmetcrest lived, was lower and more continuous than today. As glaciers melted, the paramo zone moved upward and became restricted to small pockets on mountaintops. Today, only the tallest summits, possessing the appropriate type of scrub and woodland, harbor the helmetcrest, whose isolation into four patches might have begun as recently as 20,000 years ago.

Should the climate become colder and glaciers push down the paramo habitats once again, I predict that the four isolates would come in secondary contact as their preferred habitat became continuous or nearly so. If complete speciation has taken place by the time of this secondary contact, geographical overlap might occur, and a region formerly inhabited by one ancestral species could be occupied by two daughter species. Such speciation may be a corollary of fluctuations in the environment that, in turn, resulted from climatic changes during the glacial–interglacial cycles.

Much of the previous reasoning is based on the assumption that a species' habitat requirements are largely invariant in time. This is not, however, necessarily the case. The bar-winged cinclodes (*Cinclodes fuscus*), a brown, dipperlike bird that runs along the ground in search of insects and other small animals, is one of several wide-ranging high Andean birds that have geographically variable requirements. In some parts of the high Andes, this species of cinclodes is found in relatively dense and moist grassland, whereas elsewhere it inhabits much drier and more open scrub. If its habitat requirements vary geographically, there is no reason to believe they did not also vary temporally.

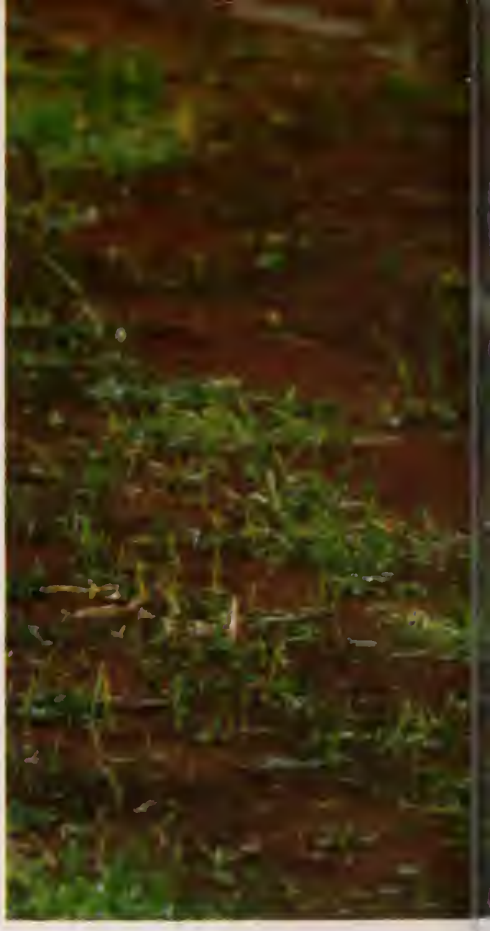
Another complicating factor is that species do not live alone; they share their preferred habitat with other species. To what extent are the habitat preferences of one species modified by the presence (or the absence) of another species, especially an ecologically similar relative? Does interspecific competition somehow rule how many species can live together in the same patch of habitat? While competition between species is an important ecological—and hence also evolutionary—factor, the precise role of competition in determining species ranges and influencing speciation (or extinction) is currently under great debate.

After an extensive analysis involving seventy-nine species of land and freshwater birds endemic, or restricted, to the high Andes (representing about 44 percent of the total avifauna), Daniel Simberloff of Florida State University and I found good evidence that competition had been a causal factor in the distribution pattern for no more than six of the seventy-nine species. For example, in the case of canasteros (small, drab birds of the genus *Asthenes* that look like long-tailed wrens and build dome-shaped, covered nests), the distribution pattern is a mosaic in which several species do seem to replace each other at given study sites, rather than coexist. We concluded that the species of canasteros are mutually exclusive,

A Greensmith, Ardea London



Peter W Post



Several Andean bird species are widely distributed: the bar-winged cinclodes, above, breeds from Colombia to Patagonia. The distribution of others is more restricted: the ochre-naped ground tyrant, right, breeds in the Patagonian Andes and migrates north to winter in the puna *of Peru.*

a situation likely to result from interspecific competition. But in many other species, the primary causal agent of their Andean distribution may be associated with the glacial cycles. Competitive interactions may occur at all times, but in most cases, the ever changing nature of the external environment would probably prevent interspecific competition from lasting long enough to settle distribution patterns as it has with the canasteros.

So far I have examined some mechanisms that help explain species dynamics in the high Andes once ancestral species occupied the newly opened habitats that formed after the mountains reached great heights. But how old is the fauna, and where did the ancestral stocks come from? A classic way of answering these sorts of questions has been first, to look at levels of endemism—which can provide an indication of the age of the fauna and the relative importance of immigration and local speciation—and then to compare the fauna with others nearby that might have received or contributed species during the time being considered. What do these two aspects of faunal analysis tell us about high Andean birds?

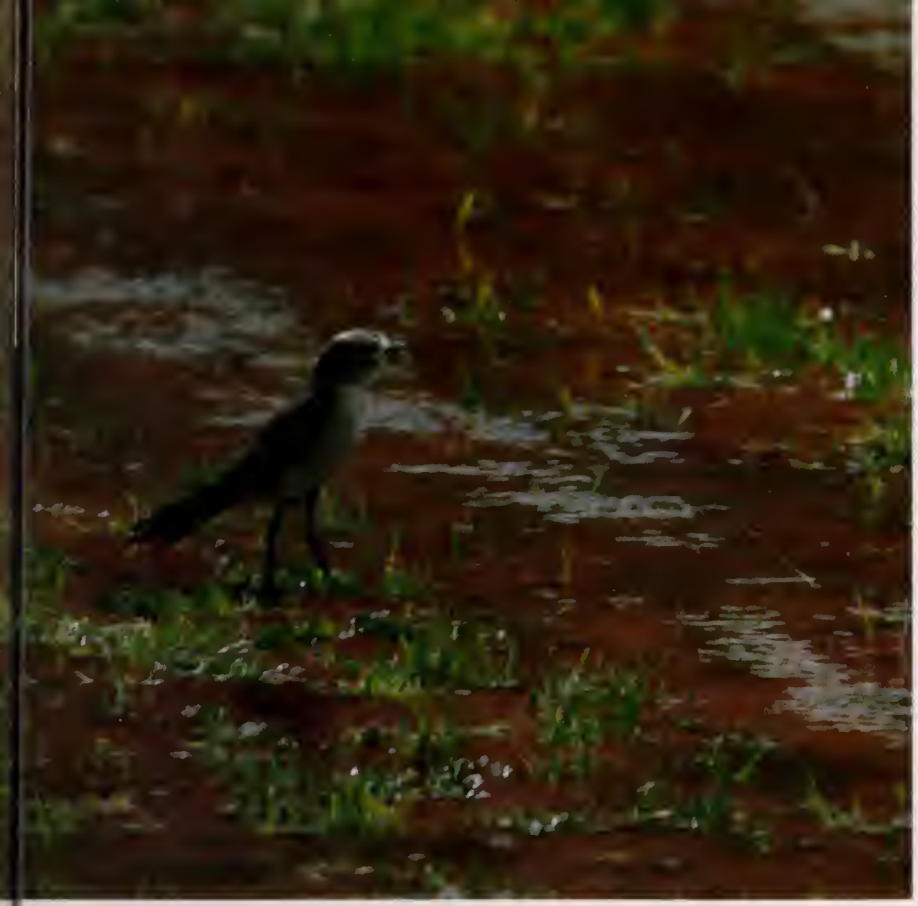
In the high Andes, endemic taxa would be those restricted to above timberline. The problem with this definition is that while some places have a sharp timberline, which effectively delimits two drastically different habitats (for example, cloud forest below, paramo grassland above, as in Colombia), in other areas (including the western slopes of the Peruvian Andes) there is no timberline. In the analysis that Simberloff and I carried out, we defined as endemic a taxon that lived only in the paramo and *puna* types of vegetation. We studied 147 species at forty sites (the total avifauna includes about 180) and found 79 to be endemic. In other words, nearly half the high Andean species are endemic, a rather high percentage.

In contrast, very few genera—4 out of 85—are endemic according to the same definition: a wader (*Phegornis*), two hummingbirds (*Oreotrochilus* and *Oxypogon*), and a finch (*Idiopsar*). Finally, not a single avian family is endemic.

The low level of endemism at the genus level suggests a relatively young fauna. The high percentage of endemism at the species level, however, could indicate a rather old fauna. This apparent contradiction might be resolved if the species endemism is the result of a high rate of recent speciation. This speciation could be either local—that is, occurring only within the high Andes—or the result of immigration followed by differentiation.

In birds, speciation is generally thought to be allopatric, involving the geographical division of a single species into two or more daughter species. Two good examples of local speciation in the high Andes include the white-throated and red-backed sierra finches, *Phrygilus erythronotus* and *P. dorsalis*, which look a little like oversized juncos, and the plain-capped and cinereous ground tyrants (*Muscisaxicola alpina* and *M. cinerea*), slender, long-legged, terrestrial flycatchers. In both cases, the two species replace each other geographically except in a very narrow contact zone. A later stage in speciation is sympatry, when two formerly isolated species live together in the same habitat or share the same distributional range. I consider the plumbeous (*P. unicolor*) and red-backed sierra finches to be such a sympatric pair, as are the cinereous and *puna* (*M. juninensis*) ground tyrants.

To determine how much speciation has occurred *in situ*, we attempted to arrive at an estimate of the number of allopatric and sympatric species among the 147 birds in our study. Allopatric species representing recently completed speciation number about 12 to 20; sympatric species that



may have been the result of local speciation number between 21 and 55. The variability in these figures reflects uncertainties in interpreting the data. A conservative estimate would be that about 20 to 25 percent of high Andean species are the result of local speciation. The rest, the overwhelming majority, therefore appear *not* to be the result of local speciation (unless their speciation is so ancient that it cannot be detected in present-day distribution patterns). This breakdown of species suggests, then, a high influx of immigrants, which in time have become endemic to the high Andes. In either case—local speciation or immigration—the age of the fauna remains largely unknown.

Determining where ancestral stocks came from can be equally complicated. We can compare lists of species living in paramo or *puna* vegetation with species living in other types of Andean vegetation (such as cloud forests and the open woodlands of the intermontane arid basins) or in the Patagonian steppes. This comparison reveals that the high Andes share more species and genera of birds with the Patagonian steppes than with any other ecological unit. This is not surprising since these two habitats are structurally very similar. The Andean *puna* and the Patagonian steppes, for example, share 48 percent of the total species found in them, while only 13 percent are shared by the *puna* and the geographically closer cloud forest. This would appear to vindicate F.M. Chapman's view, first published in 1917, that paramo- and *puna*-dwelling birds originated in southern South America, including Patagonia, and moved northward and altitudinally upward along the Andean corridor, colonizing as far as Venezuela and extreme northern Colombia. But Andean birds may also have contributed to the Patagonian fauna, and there may have been other routes of exchange as well. Birds of the *puna* and birds of the intermontane arid basins of the central Andes are somewhat related faunally; these regions share up to 30 percent of the species living in them, so that some exchange appears possible. Several high Andean genera and some species also occur in North America, which suggests another possible avenue of faunal flow. Examples among the species include the marsh hawk, the great horned owl, and the eastern meadowlark; among the genera, the stiff-tailed ducks, avocets, and flickers.

What can one conclude? Reconstructing the avifaunal history is clearly not easy. Readers interested in cautious scientific interpretations can turn to my technical papers; here let me indulge in speculation on a few of the birds found in the high Andes.

Once upon a time in the late Tertiary, about two to three million years ago, the Andes were not very tall mountains. In what is now Colombia and Ecuador to the north, their tops were either clad with cloud forest or, on the highest summits, covered with scrub. The high-altitude avifauna there included flycatchers, hummingbirds, tanagers, cotingas, and antbirds. Farther south, in Bolivia, plateaus were covered with savannas and woodlands, where caracaras, finches, and blackbirds lived.

As orogeny proceeded and the mountains increased in altitude, local timberlines developed, and above them appeared a cold, treeless habitat dominated by grasslands and moorlands. The formation of this habitat, the precursor of today's paramo and *puna*, was the turning point in the faunal history of the high Andes. At first, few birds other than wide-ranging species that normally inhabit open spaces—ducks, coots, ibises, and waders in moist areas and lagoons, hawks in dry places and cliffs—could live in these habitats.

Some of these birds are good fliers and could have come from almost anywhere: from lower down the mountainsides, provided the slopes were not forested; from southern South America; and even from North America. Today's paramo and *puna* are inhabited both by relicts of these early colonizations and by wide-ranging species that have invaded the high Andes more recently. Single stray birds from the lowlands, such as the wattled jacana (*Jacana jacana*) I saw at 10,000 feet in northwestern Argentina, are unlikely candidates for colonization. But many birds travel in flocks and can thus potentially stay and breed in areas far from their normal range.

Seed-eating finches and doves invaded the high Andes above timberline soon after seed-rich grassland habitats opened up. Little adaptive modification was required of these birds. Siskins—finches whose flocking behavior and wandering tendencies make them excellent colonists—could have come from almost anywhere. Since they eat buds and other veg-

etable matter as well as seeds, they might easily have shifted from a forest to a shrub environment. In the *puna*, the endemic thick-billed siskin (*Spinus crassirostris*) appears to be restricted to some very high altitude woodlands found within the grassland and scrub and may have derived from the smaller-billed hooded siskin (*S. magellanicus*), a species with a wide range and broad habitat tolerance. The buntings, which include the yellow-finches, may have moved in from open areas farther south, perhaps the grassy pampas or the Patagonian steppes, rather than the forested slopes below the newly formed paramo and *puna* zones. The arid woodlands of the montane basin, however, are almost as likely an original habitat for these stout-billed finches. As for the doves, they probably came from lower altitudes, and originally perhaps from North and Central America.

What about the small, brown ground-dwelling miners, other members of the diverse family Furnariidae, and the ground tyrants of the genus *Muscisaxicola*? These birds subsist on a diet that consists primarily of insects. Since none of the high Andean furnariids appear related to Central American stocks, they would seem to have come from farther south or southeast in South America, either the campos (grasslands) of Brazil, the pampas, or the Patagonian steppes. But they could also, in part, have evolved locally in the central Andes, from stocks living in cloud forests down the slopes. The landscape probably progressed slowly enough from savanna or woodland to arid grassland or shrubland for such an ecological and evolutionary transition to be possible.

The *Muscisaxicola* ground tyrants are an extraordinary group of birds with unusual habits—for flycatchers. They live away from trees and hop and run along the ground on their long, thin legs. The proto-*Muscisaxicola*, having "discovered" the ground niche, then diversified into a large number of species by allopatric speciation, a good example of adaptive radiation. Several of the species are exclusively high Andean. Did they originally come from stocks already living in open spaces elsewhere, such as Patagonia? Perhaps, but not necessarily. While eight or so species of ground tyrants do live in open habitats along the Andean axis, from mountaintops in Colombia to southernmost South America, one species lives along rivers at the forested base of the Andes. The possibility thus exists that the ground tyrants evolved from lowland ancestors living in openings in forested habitats. The ecological preferences of the closely related chat tyrants (genus *Ochthoeca*) may shed light on the origin of the high Andean ground tyrants. Chat tyrants encompass all ecological intermediates, from cloud-forest species to arid-scrub species living high up in the *puna*, without much morphological or behavioral change. One species, the brown-backed chat tyrant (*Ochthoeca fumicolor*), even shows intraspecific variation in habitat preferences: in the Venezuelan Andes, for instance, I have observed these birds in dense montane woodlands at about 11,000 feet and in increasingly more open habitats all the way up to 14,500 feet in desert paramo.

If the chat tyrants have invaded the geologically young paramo and *puna* habitats from lower-altitude

The twenty-foot-tall puyas (relatives of the pineapple) growing at 13,000 feet in Peru, below, and the yellow-finch resting on a cushion plant in Bolivia, right, are characteristic of puna *landscapes.*



Francois Vuilleumier



A Greensmith, Ardea London

NATURAL HISTORY MAGAZINE

NEW SUBSCRIPTIONS OR RENEWALS

SAVINGS CERTIFICATE

FOR THE SUM OF 9 DOLLARS

For _____

This Subscription Savings Certificate represents a saving of $9.00 off the single-copy newsstand rate for a full year (12 issues) of NATURAL HISTORY magazine, and includes membership in the American Museum of Natural History as well.

☐ **YES!** Please send me a full year of NATURAL HISTORY for the low rate of $15 for twelve issues, and my membership card.

☐ I want to save more. Send me two years of membership and 24 issues (two years) of NATURAL HISTORY for only $26 (a $22 savings off the newsstand rate).

☐ I want to save even more. Send me three years of membership and 36 issues (three years) of NATURAL HISTORY for only $35 (a $37 savings off the newsstand rate).

☐ Payment enclosed ☐ Bill me later **Send gift to:**

Name _____ (please print) Name _____ (please print)

Address _____ Address _____

City _____ City _____

State _____ Zip _____ State _____ Zip _____

☐ New ☐ Renewal ☐ 1 year $15 ☐ 2 years $26 ☐ 3 years $35

Outside of U.S. and Canada, add $3 per year. Please allow approximately 7 weeks for delivery of first issue.

J509

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD
FIRST CLASS PERMIT NO. 30 BERGENFIELD, NJ

POSTAGE WILL BE PAID BY ADDRESSEE

NATURAL HISTORY
P.O. Box 4200
Bergenfield, N.J. 07621



1981

July

SUN	MON	TUES	WED	THURS	FRI	SAT
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

August

SUN	MON	TUES	WED	THURS	FRI	SAT
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

September

SUN	MON	TUES	WED	THURS	FRI	SAT
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

NATURAL HISTORY

Clay figure approximately three inches high from the Harappan civilization which dates from about 2,300 to about 1,600 B.C. The figure was excavated in Pakistan. Photograph by Lee Boltin; funded by the Henry Luce Foundation.

ED	THURS	FRI	SAT
4	5	6	7
1	12	13	14
8	19	20	21
5	26	27	28

December

SUN	MON	TUES	WED	THURS	FRI	SAT
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

NATURAL HISTORY

A Gandharan frieze of gray schist from about the fourth century A.D. The toga worn by the Buddha, center, indicates the Greco-Roman influence on Indian art. The frieze measures about 10 x 15 x 2½ inches. Gift from the Lester Wolfe Collection. Photograph by Arthur Singer, AMNH.

montane forests, their distribution pattern may represent an earlier stage in the origin of ground tyrants. When it inhabited montane forests, the proto-*Muscisaxicola* of the high Andes might have looked and behaved like a chat tyrant, and then become modified during further evolution in the treeless *puna* and paramos. Eventually only the high-altitude species survived.

Figuring out what direction the shift in habitat preference took, however, is not as straightforward as it might seem. At face value, if there are currently more species in one habitat (*puna* or paramo) than the other (montane forest), the shift would appear to be from *puna* or paramo to forest. But speciation and extinction cycles, mediated by the external environment and modified by competition, could have turned things around so that today's lowland, forest-dwelling little ground tyrant could be either an ecological relict of the early forest history of the genus or a recent colonist from high-altitude, open habitats. Because it is almost as highly modified morphologically as the ground tyrants of high altitudes (or high latitudes, in Patagonia), I propose that the little ground tyrant is more likely to be a recent colonist.

This rough sketch gives an idea of the many different ways in which the birds of the high Andes may have evolved. Some species originated right there from ancestors that lived in more forested environments when the mountaintops were not so high; some are relative newcomers whose ancestors came from North America, from southern South America, or from the dry lowlands at the base of the Andes. Complicating the picture, some species are little different in morphology and behavior from closely related birds found elsewhere, while others have had a longer, more complex history. Challenged to reconstruct this history from often woefully inadequate evidence—involving shifts in habitat preference that trail far back in time, speciation between isolated mountaintops, and morphological and behavioral adaptations to the high Andes—the biogeographer may occasionally have cause to envy detective Hercule Poirot. □



Winners of the 1981 Natural History Photographic Competition

Participation in this year's Photographic Competition was enthusiastic, and many contestants were attracted by the announcement of a new category, Historical Photographs. With each entrant allowed to submit up to five pictures, thousands of photographs arrived at our offices for examination. The task of the three judges was to view approximately 400 slides and prints chosen as finalists by *Natural History*'s designer and picture editor. Presiding this year were David Doubilet, an award-winning photographer for the National Geographic Society, who specializes in underwater work; Ken Heyman, a photographer widely recognized for his interpretation of the human condition, who collaborated with Margaret Mead on numerous projects, including the books *Family* and *World Enough*; and Mary Ellen Mark, a noted free-lance photographer whose credits include the books *Passport*, *Ward 81*, and *Falkland Road*.

In handing out the various prizes, the judges deviated in one respect from the announced provisions of the competition. In one of the major categories, Plants and Their Environment, they were faced with a black-and-white photograph and color photograph that they admired equally, and so declared a tie for first place. First Prizes were bestowed without such indecision in the other two major categories: Animals and The Human Family. Additional photographs earned Merit Awards in Photomicrography, A Sequence in Nature, Historical Photographs, and Humor in Nature, while nine entries received Honorable Mention. Finally—with some apologies for their unconventional choice—the judges awarded the Grand Prize to the one photograph that most impressed them.

Our thanks to all who took part in this year's contest. The deadline and rules for the 1982 competition will be announced in a future issue of *Natural History*.

Vittorio Maestro



FIRST PRIZE
The Human Family
NANCY L. WEINBAUM
A cousin cheerfully helped out by holding up the subject when Nancy L. Weinbaum photographed her six-month-old niece back in 1976. Weinbaum, a high school teacher who lives in Trenton, Florida, teaches art classes and is adviser for her school's yearbook and newspaper.





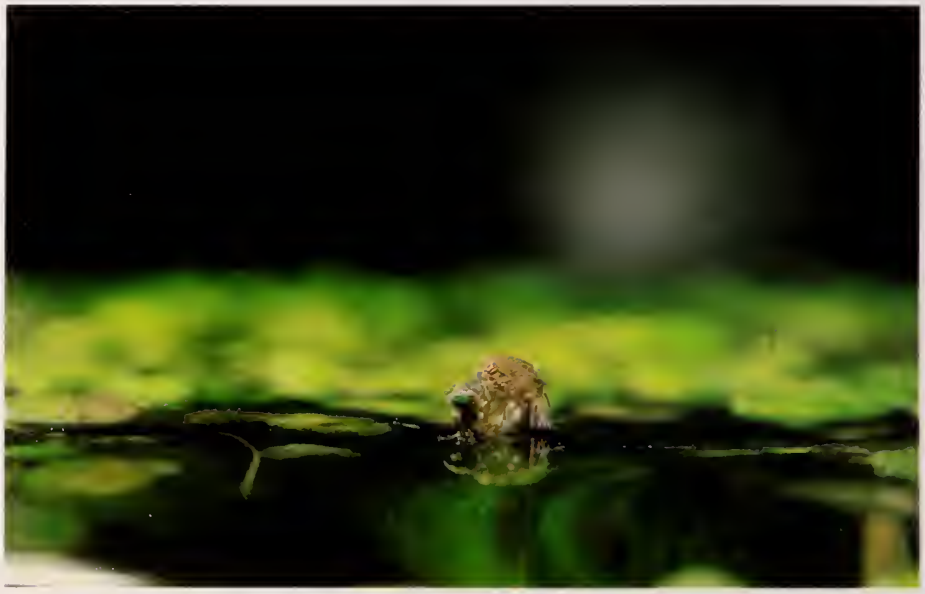


FIRST PRIZE
Animals
TOWNSEND WEEKS

A grant from the College of Marine Studies at the University of Delaware enabled marine biologist Townsend Weeks and a colleague to spend the summer of 1977 taking photographs at Cape Henlopen, on the Delaware coast. While in Canary Creek Marsh, Weeks noticed a spider moving rapidly on an Iva *plant and managed to take two pictures, this one with the flash held slightly behind the leaf. Seconds later, the spider was gone. Weeks now lives in Northvale, New Jersey, and teaches general and field ecology at Ramapo College.*

FIRST PRIZE (Tied)
Plants and Their Environment
KEITH AXELSON

Five years ago, Keith Axelson was spending his weekends at a ranch in San Luis Obispo County, California, studying the nesting behavior of golden eagles. One hazy spring day, when an eagle landed down below him, Axelson's attention was drawn to a mule deer, and he managed to grab a camera from his blind in time to snap its picture. A California live oak dominates the landscape. Axelson, a free-lance graphic designer and photographer, lives in Los Angeles.





MERIT AWARD
A Sequence in Nature
G. I. Bernard

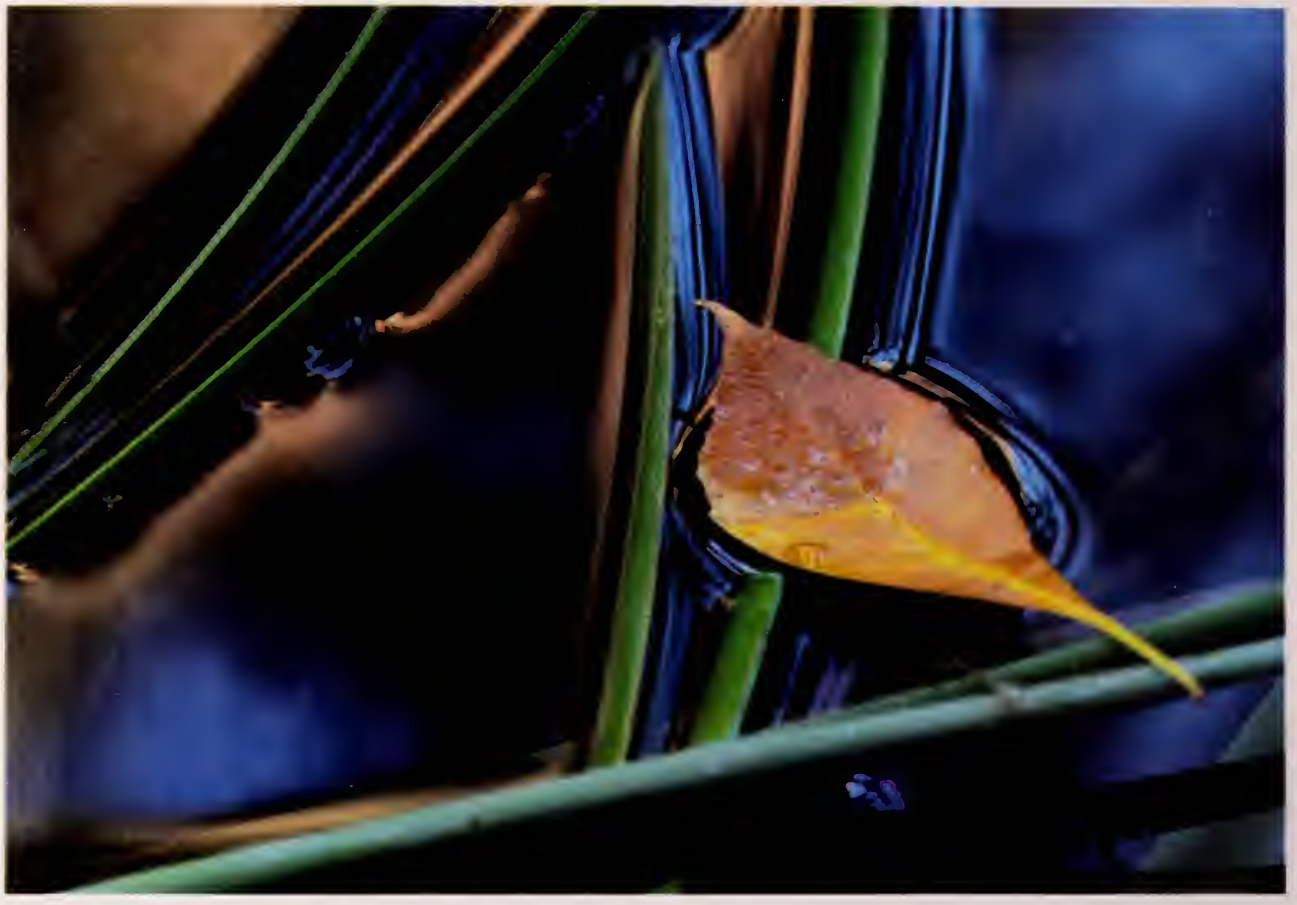
In a marsh environment set up in the laboratories of Oxford Scientific Films in England, a common female mosquito emerges from the pupal stage beneath the water. Air taken on by the mobile pupa makes it buoyant enough to break the water's surface and enables the adult flying machine to separate from its aquatic shell. G. I. Bernard, a professional still photographer on the staff of Oxford Scientific Films, captured the four- or five-minute sequence using a camera fitted with an old microscope lens.











FIRST PRIZE (Tied)
Plants and Their Environment
BETTY RANDALL

A box elder leaflet lies among cattail stems in a bog in Utah's Zion National Park. The photograph, taken in the shadows of a canyon that is about 2,000 feet deep, captures reflected, rather than direct, sunlight. Betty Randall is a free-lance photographer who lives in Coarsegold, California.

MERIT AWARD
Photomicrography
SUZANNE GROET

Resorcinol is a chemical used in manufacturing resins, dyes and other products, and in veterinary medicine as a topical antiseptic. In the form of a "melt crystal," created when a crystal melts and recrystallizes on a slide, resorcinol displays artistic qualities as well. The photomicrograph was made with polarized light, using a Zeiss microscope to provide X32 magnification; the color was modified by a retardation filter. Suzanne Groet, a botanist living in Upper Arlington, Ohio, began taking photomicrographs four years ago.





GRAND PRIZE
LEE D. FILERMAN

Although he lives in New York City, Lee D. Filerman found out that in 1980, the best place to photograph the Statue of Liberty was Lake Mendota, Madison, Wisconsin. It seems that when the flamboyant Pail and Shovel Party seized control of the student government at the University of Wisconsin, they lost no time fulfilling their campaign promise to bring the Statue of Liberty to Madison. At a cost of $4,000, the students erected a styrofoam, metal, and wood structure to represent the statue, which, they claimed, had sunk through the ice. The Pail and Shovel Party sculpture has since been disassembled, while the party itself, having left the student government in debt, keeps a low profile. Filerman, a work force administrator and grant writer, has no professional training in photography, although he has been at it for many years.









MERIT AWARD
Humor in Nature
DAVID RUSSELL MILLER

While visiting a hospital treatment center one day, David Russell Miller began taking photographs of a man at work in his garden next door. After a few minutes, the man stopped working and slowly climbed the stairs. He was not aware of the photographer until he turned and sat down, whereupon he smiled and doffed his hat. Miller, a chemical engineer who lives in Oakland, California, titled his work "Ascent of Man."



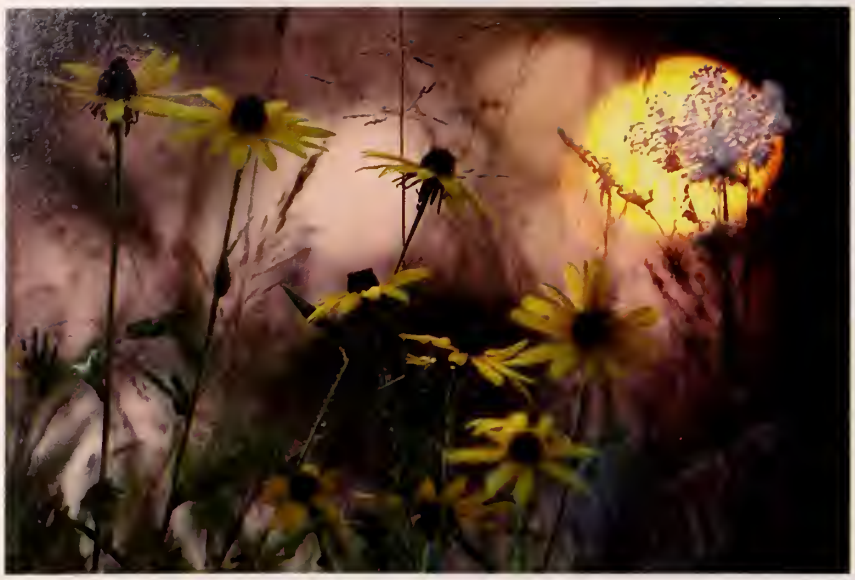
HONORABLE MENTION
Plants and Their Environment
RUTH FREEDMAN

Ruth Freedman likes to experiment with close-ups of flowers, leaves, and other natural forms. Here, the inner sections of a bell pepper are aglow with transmitted light. Freedman, a housewife in Stockton, California, has long enjoyed photography as a hobby.





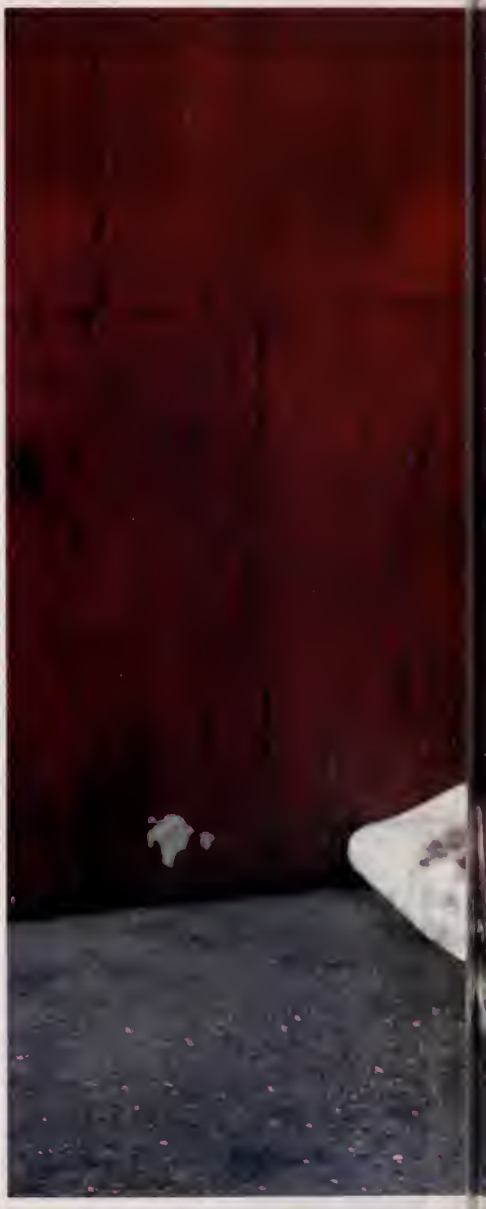




HONORABLE MENTION
Plants and Their Environment
ERIC ALBRECHT

The rays of the sun, setting over a hill near Magnolia, Ohio, filter through black-eyed Susans and Queen Anne's lace. Eric Albrecht is a newspaper photographer in New Philadelphia, Ohio.





HONORABLE MENTION
Animals
J. R. SCHNELZER

J. R. Schnelzer, a teacher and naturalist living in Westerville, Ohio, raises cecropia moths to photograph their life cycle. This one was attracted to a columbine in Schnelzer's wildflower garden.



HONORABLE MENTION
The Human Family
F. B. GRUNZWEIG

Long-time professional photographer F. B. Grunzweig has a special interest in the homeless people who live in his native New York City. This photograph of a human scene, which in Grunzweig's view expresses defeat, was taken behind the city's main bus terminal on a Sunday afternoon in the summertime.



MERIT AWARD
Historical Photographs
CARY HULL

This scene in the redwood region of northern California is reproduced from a glass-plate negative exposed about 1905 by a professional photographer, Jesse A. Meiser. Meiser, who died in 1939, had his primary studio in Eureka, California. The photograph was entered in our competition by Cary Hull, who printed a collection of Meiser's glass plates and has reproduction rights to the prints. In addition to doing free-lance photographic work, Hull is a conservationist with the Soil Conservation Service. He lives in Albuquerque, New Mexico.



HONORABLE MENTION
Animals
RICHARD SCHOER

While in the Monte Verde Cloud Forest Reserve in Costa Rica, Richard Schoer wanted to photograph Bufo periglenes, *the secretive "golden toad." Ranger "Wolf" Guindon advised him that the best time to find members of this species was in the middle of the night, during their mating season. These are males that have come to a water hole to await the appearance of females. Schoer, a resident of New York City, works as a free-lance photographer and sculptor's assistant.*

The original, indispensable KLUGE® BAG

The "No-Waiter"

A six piece set in one easy to carry-on ...for overnight or around the world.



Two time TV Emmy Award Winner Stan Hart: "The Kluge Bag is the best. The only piece of luggage I ever use."

Pennsylvania cattleman Robert Johnson: "For quality, convenience, organization, the Kluge Bag tops any set of luggage I've ever used."

Kingport, Ltd. President Ed Gerch: "One carry-on piece sure beats three or four check-in bags. I'm delighted."

Here's the famous original you'll see on the Concorde, the Air-Shuttle to Washington, the commuter out of O'Hare. The Kluge® Bag. The only combination overnighter and fortnighter in the world.

And the only bag that's as easy to carry to the last airline gate with a complete wardrobe as it is with a single change of clothing.

A "no waiter" you never check in. Never have to wait for at the baggage counter.

Extra Comfort and Convenience

You'll use the Kluge Bag like a week-ender, too, because it's just as easy to carry on and a whole lot better. Better because nothing gets wrinkled or creased... because you have extra room for all the reports and papers you need, the tennis things you may or may not use, the sweater you'd like to be able to knock around in at night, and to bring back anything from reports to a new suit you pick up on your trip. (You can prove it yourself at our risk!)



Beautifully Organized

The almost infinite flexibility is the result of an organization system designed by Peter Kluge, an international businessman, who travels constantly, from Chicago to Dallas, New York, Los Angeles, to Europe and the Middle East, never sure if he'll be away two days or two weeks, or of the clothing he'll need.

So, in one lightweight, compact, easy-to-carry handle or shoulder bag you get (1) a garment bag that holds two suits, (2) a pullman case, (3) a week-ender, (4) a tote-tennis bag, (5) a toilet-accessories kit, (6) a laundry-wet stuff bag...plus a full-size portfolio. Compartmentalized for easy access to your shirts, ties and belts; shoes and socks; underwear; suits, slacks and jackets; sportswear, sweater, bathrobe; business reports and papers. Anything and everything you need.



One Vs. Two, Three or Four

You can't even begin to compare the ease and convenience of the Kluge (rhymes with huge) Bag with the bulky, heavy, loaded-down check-in luggage you usually carry on trips of three, four or more days.

The Kluge Bag alone easily outcarries a garment bag, a weekender or pullman plus a dispatch case. It not only looks better, weighs less, it's also much easier to carry and leaves your hands free to get your wallet or ticket. The Kluge Bag comes with a specially designed hook which allows you to hang it in the garment compartment of the plane. Most important of all, only the Kluge Bag is always ready when you are to get off the plane.

Top Quality Construction

Simply, there's no other piece of luggage anything like this. Beautifully made of top-quality rayon, the material that's most often used in expensive luggage today because it's as strong as it is light, and will retain its beauty through years of use and abuse, the Kluge Bag is available in natural canvas color with rich brown piping and in striking solid black diamond and brown trim.

Outside there are three sectional zippers, so you can get to anything in a second, with a security snap lock and a valet snap lock safety strap, plus comfortable carrying handles and the adjustable burden-bearing shoulder strap.

Inside, a fold-up rigid bottom supports everything you can carry in the zippered main compartment. The fittings and details are equally impressive, like a tie rack, a fitted compartment for toiletries, a zippered compartment for valuables, pockets for cards, notes, keys and more. Plus a huge volume portfolio. Everything you need to make packing and traveling for days or weeks easier and faster than it's ever been before. Yet fully packed the Kluge Bag is just 19" high by 22" wide and 8" deep.



Only $49.95!

Most extraordinary of all, though, is the price. At $90 and $100, which is the price you'd have to pay for a bag like this in a fine retail store, the Kluge Bag would be an excellent value. At **$49.95** plus $4.95 shipping and handling, it's absolutely unbeatable.

A price that's possible because we're able to commit for an entire manufacturing run, and to eliminate salesmen, distributors and retailers and their costs by selling direct.

No Risk Trial

Now we invite you to try the Kluge Bag for yourself — for 30 days without risk or obligation. Don't worry about how you handle it. Nothing will hurt it. You must be convinced that it's the finest, most useful, convenient and versatile piece of luggage on the market today, a time and trouble saver, the perfect piece for every trip, or return it for a complete refund. No questions asked.

CALL 800-228-5959

Nebraska residents call 800-642-8777
(In operation 24 hours, 7 days a week)

The Kluge Bag is also available with rich belting leather trim. The price is just **$79.95** plus $4.95 shipping and handling.

NEW! As a result of thousands of calls, an all leather Kluge Bag is finally available. Made of the finest, softest, most durable dark brown leather, it can only be used with pride. Only $250.00 plus $4.95 shipping and handling. When ordering, please specify, the *ALL LEATHER* Kluge Bag.

To order with any major credit card, just call us at the toll free number above. Or send your check to Dimensions Unlimited, Inc. at the address below. (Illinois residents please add 6% sales tax.) Be sure to specify natural or black with vinyl or leather trim, or the new *ALL LEATHER*. Take the lug out of luggage, the wait out of baggage.

DIMENSIONS UNLIMITED, INC.

Dept. 62-2507
400 S. Edward Street
Mt. Prospect, IL 60056

© Dimensions Unlimited, Inc. 1981

HONORABLE MENTION
Animals
NELSON CHENKIN

At Bear Lake, in Colorado's Rocky Mountain National Park, the winter sun silhouettes a bird that has obligingly landed in the right place and presented its profile. Nelson Chenkin, who lives in Fort Collins, Colorado, is a service mechanic for trucks and trailers.





HONORABLE MENTION
Animals
JENNIFER SHAULL

In Kenya's Amboseli National Park, on a study trip focusing on wildlife conservation, Jennifer Shaull had the opportunity to view (from a respectful distance) a glutted lioness at a zebra kill. A landscaper in Laurel, Maryland, Shaull reports that this safari provided her first experience in photography.

Full-Line Leica dealers:

ARIZONA—Phoenix: Foto Forum, Guild Camera

CALIFORNIA (Northern)—Berkeley: Berkeley Commercial Photo **Larkspur Landing**: The Camera Company **Monterey**: Ken s Cameras **Palo Alto**: Keeble & Shuchat **San Francisco**: Adolph Gasser, Brooks Cameras, The Darkroom, Pacific Camera **San Mateo**: Brooks Cameras **Santa Cruz**: Camera Connection **Stockton**: Gluskin s Camera Corner **Walnut Creek**: Photo Center

CALIFORNIA (Southern)—Beverly Hills: Beverly Hills Camera **Costa Mesa**: Cal s Cameras **Goleta**: Tony Rose Camera **Hollywood**: Bob Gamble s Photo **Los Angeles**: Bel Air Camera Frank s Highland Park Camera Kimura Photomart, Olympic Camera **Pasadena**: Alvin s Photo, Lee-Mac Camera Exchange **Redondo Beach**: Riviera Camera Shop

COLORADO—Aspen: Walnut House **Denver**: Gart Bros Sporting Goods, Waxman Camera Werner s Mile High Camera **Grand Junction**: Monument Photographic Corp

CONNECTICUT—Hamden: Karber Photo **Hartford**: Camera Bar **New Haven**: Fair Haven/Fairgraphics

DELAWARE—Wilmington: Lincoln Camera

DISTRICT OF COLUMBIA—Washington: Penn Camera Exchange, Prn Photo

FLORIDA—Casselberry: International Camera **Coral Gables**: Mileo Photo Supply **Fort Lauderdale**: Clik Camera Shop **Lake Worth**: Quality Photo Service **Miami**: Benson s Camera, Bristol's, Downtown Camera, Miami Camera Center, Pitman Photo **Palm Beach**: Ramon s Camera Shop **St. Petersburg**: Abner s Camera Exchange **Tampa**: Southern Photo & News

GEORGIA—Atlanta: Crown Camera Exchange, Wallis Kamera Haus

HAWAII—Honolulu: Francis Camera Shop

IDAHO—Boise: Idaho Camera

ILLINOIS—Chicago: Camera Exchange, Central Camera, Helix Ltd., Herman Cameras, Shutan Camera **Evanston**: Poe s Camera **Orland Park**: Camera Cove **Peoria**: Peoria Camera

INDIANA—Muncie: Jack s Camera **South Bend**: Schilling s

IOWA—Iowa City: Henry Louis

KANSAS—Kansas City: Western Photo-Graphic **Topeka**: Wolfe s Camera Shop **Wichita**: Lawrence Photo

LOUISIANA—New Orleans: Alfredo s Cameras **Shreveport**: Par Excellence

MARYLAND—Rockville: Bunton Instrument **Silver Spring**: Industrial Photo **Wheaton**: Gilbert s

MASSACHUSETTS—Arlington: New England Photo **Boston**: Claus Gelotte, E. Philip Levine **Cambridge**: Claus Gelotte **Chicopee**: Piepul's Camera **Malden**: Hunt Drug

MICHIGAN—Ann Arbor: Home Appliance Mart **Birmingham**: Birmingham Camera, World Camera **Dearborn**: Adray Appliance **Muskegon**: Al Chnstopher s Camera **Royal Oak**: Century Camera

MINNESOTA—Golden Valley: National Camera **Minneapolis**: Photo Visuals

MISSOURI—Kansas City: Crick s Camera **St. Louis**: Creve Coeur Camera, St. Louis Photo **Springfield**: Ozark Camera

NEBRASKA—Omaha: Dean s Camera

NEW HAMPSHIRE—Hanover: Camera Shop of Hanover **Manchester**: The Camera Shop

NEW JERSEY—Bricktown: The Photo Center **Northfield**: Corral Camera Lounge **Parsippany**: Sight and Sound **Upper Montclair**: Photo Cullen

NEW YORK—Albany: State Photo Supply **Amityville**: Berger Bros Camera **Bronx**: Arista Camera Specialists **Brooklyn**: Focus Electronics **Buffalo**: Delaware Camera Mart **Great Neck**: Ken-Mar Camera **New York City**: Alkit Camera Shoppe, Cambndge Camera Exchange, Camera Barn, Competitive Camera, Dumont Camera, Executive Photo & Supply, 47th Street Photo, Jaydee Camera Exchange, Ken Hansen Photo, Olden Camera & Lens, Wall Street Camera Exchange, Willoughby's **Newburgh**: Seaman's **Rochester**: Photogenesis Camera Center **Schenectady**: Reales **Syracuse**: M O Camera Center **Yonkers**: Sam s Camera Exchange

NORTH CAROLINA—Greensboro: Camera World **Raleigh**: Sam Bass Camera Shop

OHIO—Akron: Metzger Photo Supply **Bedford Heights**: Laurel Camera **Cincinnati**: Growth Systems, Provident Camera **Cleveland**: The Dodd Company **Dayton**: Malone Camera **Worthington**: Don McAlister Camera

OKLAHOMA—Oklahoma City: Pipkin Photo Supply **Tulsa**: Camera Gallery, Engler Photo Supply

OREGON—Beaverton: Suburban Photo **Corvallis**: Oregon State University Book Store **Portland**: Citizens Photo, Conkling, Inc

PENNSYLVANIA—Allentown: Classic Photo Lab **Ephrata**: Lee s Camera Center **Philadelphia**: Kosmin s Camera Exchange, Photo-Cine Shop **Pittsburgh**: Kadet Photo **Reading**: Alton E Bower s Photo

RHODE ISLAND—Providence: Adler s

TENNESSEE—Memphis: Memphis Photo Supply **Nashville**: McGinnis, Inc., Photographic Systems

TEXAS—Austin: Capitol Camera **Dallas**: Cooter's Village Camera **Fort Worth**: Seymour's Photo Supply **Houston**: George Lange/Cameras; Southwestern Camera **New Braunfels**: Seidel Camera Shop **Tomball**: Custom Camera

VERMONT—Burlington: Photogarden

VIRGINIA—Charlottesville: Cary s Camera Shop **Fairfax**: Fuller and D Albert **Williamsburg**: Massey's Camera Shop

WASHINGTON—Seattle: Clyed s Camera Stores, Olympic Camera Center, University Book Store **Spokane**: Huppins Hi Fi & Photo

WISCONSIN—Appleton: Ideal Photo **Milwaukee**: Casanova's, Reimer s Photo Materials **Racine**: Camera World

Or write for more information.
E. Leitz, Inc., Rockleigh, N.J. 07647.

You wouldn't hang a Picasso in the closet. You'd show it in its best light. Proudly. Leica feels the same way about photography. It would be a pity if pictures taken with our amazing R4 weren't projected with our equally amazing Pradolux* RT300. Each is superb. Together, incomparable.



Consider the Leica* R4, the camera that's so automatic, so responsive, it can do everything, simply. It's the only camera in the world with two independent light meter systems. You can select either full-area (averaging) or selective (spot) metering with a touch of the controls. And you have multi-mode exposure automation working with the two metering systems. Again truly unique. This gives you shutter priority, aperture priority, programmed control, metered manual and flash automation in fractions of a second. And you have a full system of accessories including motor drives and the incomparable Leica-R lenses to bring all this potential to actuality, simply.





The only slide projector made to this high standard is our own: the Pradolux RT300. It offers Leica lenses in a full range from 60 to 200mm in both curved and flat-field configurations. The internal condensers are just as important as the lenses. That's why ours are Leica optical quality, too. You can count on high efficiency cooling for long life of the projector, the lamp and your slides. The Pradolux RT300 accepts Kodak Carousel* trays and stack loaders. Plus a range of built-in features that seems to go on forever.

*TM Eastman Kodak Company.

In fact, with both the Leica R4 camera and Pradolux RT300 slide projector you will see how impressive your images really are, Pablo. Ask your full-line Leica dealer for information; he's listed in the adjacent column.

Leitz

Leitz means precision. Worldwide.

HONORABLE MENTION
The Human Family
GLENN S. CAPERS

A newspaper photographer in San Bernardino, California, Glenn S. Capers went to Lima, Peru, seeking to understand the Andean people who make up about 40 percent of the city's population. Having migrated to the city from rural areas that could not support them, the Andeans live virtually without employment or public assistance. Capers, who "believes in walking," encountered a blind fiddler and sleeping boy and thought they exemplified the condition of the impoverished Andean people.



HONORABLE MENTION
Plants and Their Environment
BARRON HALEY

The Agave americana*'s "sensuous" spines made Barron Haley's entry a close contender for the Humor in Nature award. Haley, a junior college instructor in biology and botany, lives in Los Gatos, California. Although photography is just a hobby, he is able to illustrate most of his lectures with slides he has taken himself. His first involvement in photography was a lab course in photomicrography that he took sixteen years ago.*



Nomads' Best Friend

by Valerius Geist

THE CAMEL, by Hilde Gauthier-Pilters and Anne Innis Dagg. *The University of Chicago Press, $26.00; 224 pp., illus.*

Hilde Gauthier-Pilters



This is an excellent book, which I recommend if only for sheer reading pleasure. The book details—without generating boredom—the life of the camel, a remarkable creature that inhabits, along with nomad herders, some of the world's most inhospitable landscapes. The authors give a vivid introduction to the ecology of the Sahara and to the life of the animal that makes it possible for humans to exploit the hot desert. Camels and nomads live in a bond of mutual dependence: the camel needs nomads to give it water from wells in summer, and nomads need camels to provide milk, wool, transportation, and meat, and above all, to provide work and give meaning to their lives. To live by the camel requires attributes that are highly valued by all people, regardless of the society. Yet, the shadow of civilization—if one can call it such—has descended on these hardy, independent people and their way of life, as well as on their camels. If humans abandon the nomadic life, the fate of the camel will be sealed, for without humans and their wells, the camel could not live where it now is common. This is a somewhat simplistic overview, but no review could capture the detailed knowledge revealed in the pages of this book.

The work of Hilde Gauthier-Pilters has formerly been accessible only to those literate in German and French. She has written several popular books on her work, delightful accounts that minimize the very real dangers and hardships she endured as a woman scientist alone in the Sahara. In English there is only one paper, a turgid but clear account of her understanding of the ecology of camel and nomad in the Sahara. This paper, presented a decade ago at a symposium on ungulate behavior, is a classic. She had earlier studied captive New World camelids, but soon shifted to studying the ecology of dromedaries and nomads in North Africa.

Anne Innis Dagg made her name by studying giraffes and, later, the gaits of ungulates. After writing two books on wildlife management in Canada, Dagg teamed up with Gauthier-Pilters for several study trips into the Sahara. *The Camel* is the fruit of their collaboration, although it is based largely on the work of Gauthier-Pilters, who also wrote most of the chapters and supplied all the photographs. The book's first aim is to give an account of camel autecology; the second, to describe the interdependence of nomads and camels; and the third, to compile a bibliography on camel biology. The result is a most readable, informative, well-illustrated book with two appendixes and a useful bibliography. The work is divided into two parts: one deals with camels; the other with the people who depend on them.

The first part—short on theory and long on observations—is a reasonably broad, but condensed, account of what we know of camel biology. This section is well thought out and devoid of the superficialities so infuriatingly common to the "six month wonders" whose field studies too often grace our scientific journals. This book is solid stuff! Authoritatively written with plenty of hard work to back each of its sentences, the book is also an example of how the nomad's traditional knowledge of camels can be used to good advantage without losing scientific objectivity. Nowhere is there a better account and explanation of the camel's peculiarities than here.

This hard, scientific account makes it very plain why the camel, in the past, in the present, and almost certainly in the future, will be the only means by which humans can exploit the desert. Without camels the scarce desert resources are almost completely beyond human utilization, just as the tundra would be without caribou, or reindeer, as well as migratory birds and anadromous, migratory fishes. Conventional agriculture is possible on only a tiny fraction of hot desert ranges. Camel herding with its concomitant nomadism is one feasible means of survival. The practice of camel herding, however, requires free-roaming over vast areas in order to exploit rains and fresh vegetation; it cannot tolerate borders. It also requires that Occidental cultures abandon their holier-than-thou attitude toward nomads: the belief that our way

OUR NEW CAMERA VS. NOTHING ELSE.

You might say the new Minolta XG-M is in a class by itself.

Because no other 35mm SLR in its class has its combination of creative features, yet is so easy to use.

All you do is point, focus and shoot.

The automatic XG-M does everything else to give you clear, sharp, beautiful pictures. It even has electronic features to prevent mistakes. And advanced features like manual metering for advanced photographers.

To make things tougher on the competition, we gave the XG-M something you only find on more expensive cameras. The option of professional motor drive, to let you take pictures at an astonishing 3.5 frames per second.

So you can capture fast action. Like a diver's twisting entry into the water. Or a racer's moment of triumph at the finish line.

And when you hold this camera you'll know it's extraordinary, inside and out. Its built-in textured grip was sculptured to fit your hand more comfortably.

And its advanced design represents an exciting new achievement in making fine cameras. Something we've been doing for over 50 years.

The XG-M accepts over 45 interchangeable, computer-designed Minolta lenses. As well as the Minolta system of SLR accessories.

The new Minolta XG-M There's simply nothing else like it.

WAIT 'TIL YOU SEE HOW GOOD YOU CAN BE.



MINOLTA

For more information write Minolta Corporation
101 Williams Drive Ramsey N J 07446
Or see your Minolta dealer In Canada Minolta Ontario L4W 1A4

Product appearance and or specifications are subject to change without notice

©1981 Minolta Corporation

WE GO WHERE THE WONDER IS.

Out to sea, a world is waiting. The cave of Robinson Crusoe on the island of Tobago. A spectacular drive-in volcano on St. Lucia. A charming fishing village at Iles des Saintes where the children sell a cake called Love's Torment (coconut & guava). A 180 mile journey up the Orinoco River to a jungle paradise at Canaima (and a chance to see Angel Falls, the tallest waterfall in the world). It's just part of what happens aboard the Stella Oceanis as she makes one in a series of 14-day Leeward to the Orinoco Cruises out of San Juan this winter. Join us on our yachtlike itinerary. For details, see your travel agent or send this ad for our brochure or call us collect at (212) 397-6400.

Sun Line, One Rockefeller Plaza, NY, NY 10020. Room 315. Greek registry



Name_____

Address_____ NH1

City_____ State_____ Zip_____

My travel agent is_____

STELLA OCEANIS

SUN LINE

NATURAL HISTORY MAGAZINE BINDER



The functional way to save your full year's issues for future reference and pleasure. "Natural History" stamped in gold color on dark green leatherette over heavy binder's board. 12¾" x 9". Price $6.50. Members $5.85.

American Museum of Natural History
Museum Shop
Dept. 229
C PW at 79th St
N Y., N Y., 10024

Qty	Price	Shipping/ Handling	Total
		$2.00 ea	
		Order Total	
		N Y Sales Tax	
		Total Amount	

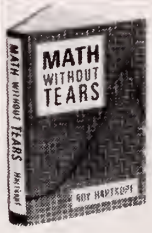
Enclosed is check money order for $_____

Name

Address

City State Zip

MATH WITHOUT TEARS



Using non-technical language and a light touch Roy Hartkopf gives you a basic understanding of many everyday applications of mathematics. He takes the reader from simple counting to trigonometry and calculus, emphasizing the practical aspects of math. Humorously written. *Learn math in the comfort of your own home at minimum cost.*

Order Now: $9.95 plus $1.10 hdlg.

EMERSON BOOKS, INC.
Dept. 797 F Buchanan, N.Y. 10511
10 Day Money Back Guarantee

CUSTOM COLOR PRINTS



from the lab that serves many top pro outdoor photographers... Write for free folder and prices.

CREATIVE COLOR Inc.
4911 — W. Grace St.
Tampa, Fl 33607
813/879-5680

We use Kodak paper... for a good look.

Hilde Gauthier-Pilters



of life is so superior we must convert all to it!

This book makes a plea of the same kind made in the *Ugly American*—that real help via technologies from the Occident does not lie in resource projects, resettlements, and jobs that destroy the fabric of the nomad's society, but in simple improvements that make life a little easier and richer. Gauthier-Pilters shows how simple, cheap improvements to existing wells would not only insure a better supply of clean water—the only kind camels will drink—but above all, could get watering done more quickly and thus save pastures in the vicinity of wells from depletion. Her knowledgeable treatment of the problems of grazing and watering in the Sahara are recommended reading for anyone interested in the problems of the Sahel.

This is an important book written by two eminently competent scientists after long studies and with due social and historical perspective. I cannot overstate that. Whether such a book could be written thirty years hence is doubtful; native cultures are rapidly collapsing, impoverishing all of us. In view of the book's significance, my minor disagreements and critiques would be quibbles. I recommend this book; please read it.

Valerius Geist is professor of environmental science on the Faculty of Environmental Design at the University of Calgary in Canada.

AMERICA IS FOR SALE

The United States Map Company wishes to inform you that the whole country can be bought: We are offering you a huge mural map of the United States measuring *NINE HUNDRED AND TWENTY-FIVE SQUARE INCHES*, with leading cities, lakes, rivers, mountain ranges, national parks, forests and historic sites in breathtaking color, *FOR ONLY $1!*

That's right, the entire country is yours for just a buck—a solitary simoleon, greenback, smacker, bof-fo, bean, eight-bit, frogskin, lettuce leaf, shinplaster.

This magnificent mural map is a real eye-popper, ideal for an office, reception area, classroom, den, or child's room.

But there is a limit: only three maps to a customer.

To get your breathtaking Mural Map of the United States, just fill out the coupon below and mail it with payment to the address shown in the coupon.

We deliver this huge map right to your doorstep. You'll have the whole country right at your feet!



UNITED STATES MAP CO., BOX 7777, NEW YORK 10001

I enclose $_____ for _____ HUGE mural maps of the United States—*NINE HUNDRED AND TWENTY-FIVE SQUARE INCHES EACH*—at the giveaway price of *ONLY $1 EACH* + 65¢ shipping; total $1.65. (Limit: three maps per customer, at a price of $4.95.)

NAME _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

Add applicable sales tax.

© U S Map Co. mcmlxxxi MNH-1

Celestial Events

by Thomas D. Nicholson





The Moon New moon occurs at the beginning and end of July (on the 1st and the 30th). First-quarter moon (rising about noon and setting about midnight) is on July 8, full moon (rising at sunset and setting at sunrise) is on July 16, and last-quarter (rising about midnight and setting about noon) is on July 24. In August, first-quarter moon is on the 7th and full moon on the 15th. The moon is at apogee (farthest from the earth) on July 11 and August 8, at perigee (nearest the earth) on July 27 and August 21.

Two eclipses occur in July, both visible in some parts of North America. A partial lunar eclipse on July 16–17 is visible throughout the United States and Canada (except for northern areas), and a partial solar eclipse occurs over Hawaii, Alaska, and western Canada on July 30.

Stars and Planets Venus will be low in the west-northwest about half an hour after sunset, when its brightness overcomes the darkening twilight. Well to the left of Venus, Jupiter and Saturn continue to put on a good show high in the southwest at dusk. Jupiter is brighter than any star in the sky. Saturn is very close and just above it. The two planets have been near one another since last autumn, their retrograde motions keeping them from separating very far. Now both are moving easterly, and Jupiter, the faster of the two, passes Saturn on July 27 and separates steadily to Saturn's left. In the morning, Mercury goes through a poor elongation in July. Mars rises about two hours before the sun in Taurus, near the Hyades and Aldebaran. The sun in July moves from the stars of Gemini into Cancer.

July 3: Mercury resumes its normal (easterly) motion. Earth is at aphelion, farthest from the sun, about 152,103,500 kilometers (94,513,000 miles) distant.

July 7: The very bright planet Jupiter is to the moon's right this evening, and Saturn is just above Jupiter. Spica, in Virgo, is to the left.

July 12–13: The moon can introduce Antares, the bright red star below it.

July 15: The bright gibbous moon will locate Sagittarius for you tonight.

July 16–17: Tonight's partial lunar eclipse begins at 10:24 P.M., EST, mid-eclipse occurs at 11:47 P.M., EST, and the eclipse ends at 1:09 A.M., EST, on the 17th. Adjust for different time zones and for daylight time.

July 28: The Delta Aquarid meteor shower reaches maximum. Up to 20 meteors per hour can be seen for two or three days before and after the 28th.

July 30: Jupiter passes Saturn (conjunction), moving from right to left. This is the third and last event in the "triple conjunction" that began last January.

August 3–4: The moon passes Jupiter and Saturn on the morning of the 4th, moving from their west (right) on the 3rd to their east on the 4th.

August 10th: Mercury is in superior conjunction, in line with but beyond the sun. It now enters the evening sky.

August 12: The Perseid meteor shower reaches maximum early this morning. This is the most reliable and productive meteor shower of the year.

The summer Star Map shows the sky from the mid-latitudes (40°N) of the Northern Hemisphere during the evening hours, at the times indicated below. To use the map, hold it in front of you vertically (facing you) with the compass direction you are facing at the bottom of the map. Thus when you face north, hold the map with north (N) at the bottom, and match the *lower* half of the map with the stars you face on the sky.

During the night the stars in the sky move continuously toward the west. By morning (before dawn) all the stars on the *western* half of the map will have set, the stars on the *eastern* half will have moved over to the *western* sky, and new stars (those of the *winter* evening) will have risen into the east. The map represents the sky at about 2:00 A.M. on July 1; 1:00 A.M. on July 15; 12:00 A.M. on July 31; 11:00 P.M. on August 15; 10:00 P.M. on August 31; 9:00 P.M. on September 15; and 8:00 P.M. on September 30. Add one hour for daylight time. The map can be used an hour or so before and after the times given.

Editor's Note: Beginning this month, the Celestial Events Sky Map returns on a different schedule, supplemented at times by other illustrations of interest. Sky Maps in July, October, January, and April will show the evening constellations and stars associated with summer, autumn, winter, and spring. The precise time for using the maps changes during the season, as the above times indicate, but the principal stars and groups can be found from the maps at any evening hour throughout the season. Other kinds of maps, sketches, and photographs during intervening months will call attention to special areas and events.

The Once and Future Museum

The American Museum of Natural History is a tangled complex of twenty-two interconnected buildings stretching from 77th to 81st Street on the Upper West Side of Manhattan. According to the *Guinness Book of World Records*, it is the largest museum of any kind in the world. The Museum has more than 99,000 square feet of windows, nearly 300,000 square feet of glass in exhibit cases, 17 elevators, 35,000 electrical outlets, 800 air conditioners and 25 acres of floor space; employs 200 scientists, working in as many offices, and 600 other employees; and stores 34,000,000 specimens in an undetermined number of rooms.

Anyone who visits the Museum must be impressed by the windings and convolutions of its thirty-eight exhibition halls. Those of us who work here know of the Museum's subterranean passageways lined with rumbling steam pipes, of its dark attics stuffed with relics and bones, and of its storage rooms containing all manner of natural history artifacts, from whale skeletons and dinosaur skulls to pre-Columbian jades and mummies.

The growth of the Museum's building has followed, somewhat fitfully and erratically, a master plan created more than a century ago. The Museum was founded in 1869, and for lack of a better space the first collections were housed in the offices of Brown Brothers, a Wall Street firm. The growing collections were later moved

Shakespeare Summerfest

A wide variety of programs, including talks, films, and performances related to the Elizabethan era, is planned in conjunction with the new major exhibition at the Museum, *Shakespeare: The Globe and the World*. For more information on programs listed below, contact Marilyn Roberts at the Education Department, American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024, or call the Museum at (212) 873-1300.

The Lover and His Lass

On Wednesday, July 15, at 7:00 P.M. in the Education Hall, a program of poetry and dance will re-create the ambiance of a candlelit dancing party in a sixteenth-century manor house. *The Lover and His Lass: Dances from Shakespeare's Time*, choreographed by Bhala Jones using sixteenth-century dance forms, is presented by the Ananda Dancers.

Dances for a Winter's Night

This program of dance includes selected sixteenth-century dances connected by quotations from dance manuals of the period. The narrative reveals the manners, morals, and often humorous insights of Renaissance life. *Dances for a Winter's Night* will take place on Tuesday, July 21, at 7:00 P.M. in the People Center, and is presented by Bhala Jones and the Ananda Dancers.

The Book in Shakespeare's Age

Daniel Traister, of the New York Public Library's Department of Rare Books and Manuscripts, will give a talk, *The Book in Shakespeare's Age*, on Wednesday, July 29, at 7:00 P.M. in the People Center.

The New Jersey Shakespeare Festival Events, Drew University, Madison, New Jersey

Lecture Demonstration in Potter's Field Acting Technique with Michael Moriarty and members of the Potter's Field Theatre Company. Saturday, June 27, at 3:00 P.M.

Violence in Shakespeare, a talk with Paul Berry, artistic director, and members of the New Jersey Shakespeare Festival Company. Saturday, July 11, at 3:00 P.M.

Dressing Shakespeare, with Nancy Potts, designer, Eaves Costume Collection. Saturday, July 25, at 3:00 P.M.

American Shakespeare Theatre Events, Stratford, Connecticut

Shakespeare's Histories, a talk by Charles A. Hallett, professor of English at Fordham University. Wednesday, July 8, at 4:30 P.M.

Shakespeare: The Literate Actor, a talk by Bernard Beckerman, professor of dramatic literature, Columbia University. Wednesday, July 15, at 4:30 P.M.

Other Shakespeare Summerfest Events

The American Shakespeare Theatre in Stratford, Connecticut, will present *Henry V*, starring Christopher Plummer, and *Othello*, starring James Earl Jones, from July 7 to September 6.

The New Jersey Shakespeare Festival in Madison, New Jersey, is offering a rotating repertory season, from June 23 to September 6, including *Romeo and Juliet* and *Cymbeline*.

The New York Renaissance Festival of the Arts will re-create the atmosphere of a Renaissance fair during the seven weekends from August 1 to September 13 and Labor Day.

The New York Shakespeare Festival will present *The Tempest* from June 26 to July 26 and *Henry IV, Part 1* from July 31 to August 30. Performances will be given Tuesday through Sunday at the Delacorte Theater in Central Park.

WNET/Thirteen will rebroadcast productions from the BBC/Time-Life series "The Shakespeare Plays."

The Chautauqua Institution of Chautauqua, New York, is sponsoring a one-week program on Shakespeare in July. The featured speaker is Sam Schoenbaum, author of *Shakespeare: The Globe and the World*, the catalog published in conjunction with the Folger Shakespeare Library exhibition.

The Yale Center for British Art is exhibiting Yale University's extensive holdings of Shakespearean art through July 5. The university is also offering a free series of Shakespearean films through August 15.

Bedouin Tent

A collection of Saudi Arabian artifacts is on display in the Roosevelt Rotunda. The focus of the exhibit is a Bedouin tent featuring objects of these nomadic people. The exhibit will also trace Arabian cultural development, from Paleolithic times to the present, through flint tools and points, pottery, and historical photographs.



"Where's the best fishing in the Gulf of Mexico? Just look for an offshore oil platform."

"If you have any doubts, ask one of the men who run sports fishing boats in the Gulf," says H. E. Braunig, a Manager of Environmental Affairs at Gulf Oil. "When they want to guarantee their customers a good day's fishing, they head straight for the oil platforms.



"Twenty universities and thousands of fish say oil platforms don't hurt the environment."

"What happens around the bottom of the oil platforms is ecologically identical to what happens around any natural reef.

"A food chain starts. Mussels, anemones, starfish, anything that likes to live on a solid underwater surface, all come first. Then the fish that feed on them; and so on, until a whole ecosystem builds up.

"Even with the oil platforms, it's life as usual in the Gulf of Mexico—even for the commercial shrimp and oyster fishermen, whose livelihood depends on clean water.

"That's living proof that offshore platforms aren't ecologically destructive. A two-year study by twenty Gulf Coast universities, concluded in 1974, says the same thing.

"Gulf people are meeting a lot of challenges in getting the oil out while preserving the environment. This problem just seemed to solve itself; and with continual environmental monitoring and sampling, on all current and future offshore sites, we intend to make sure it stays solved."

Gulf

Gulf people: energy for tomorrow.

© Gulf Oil Corporation 1981

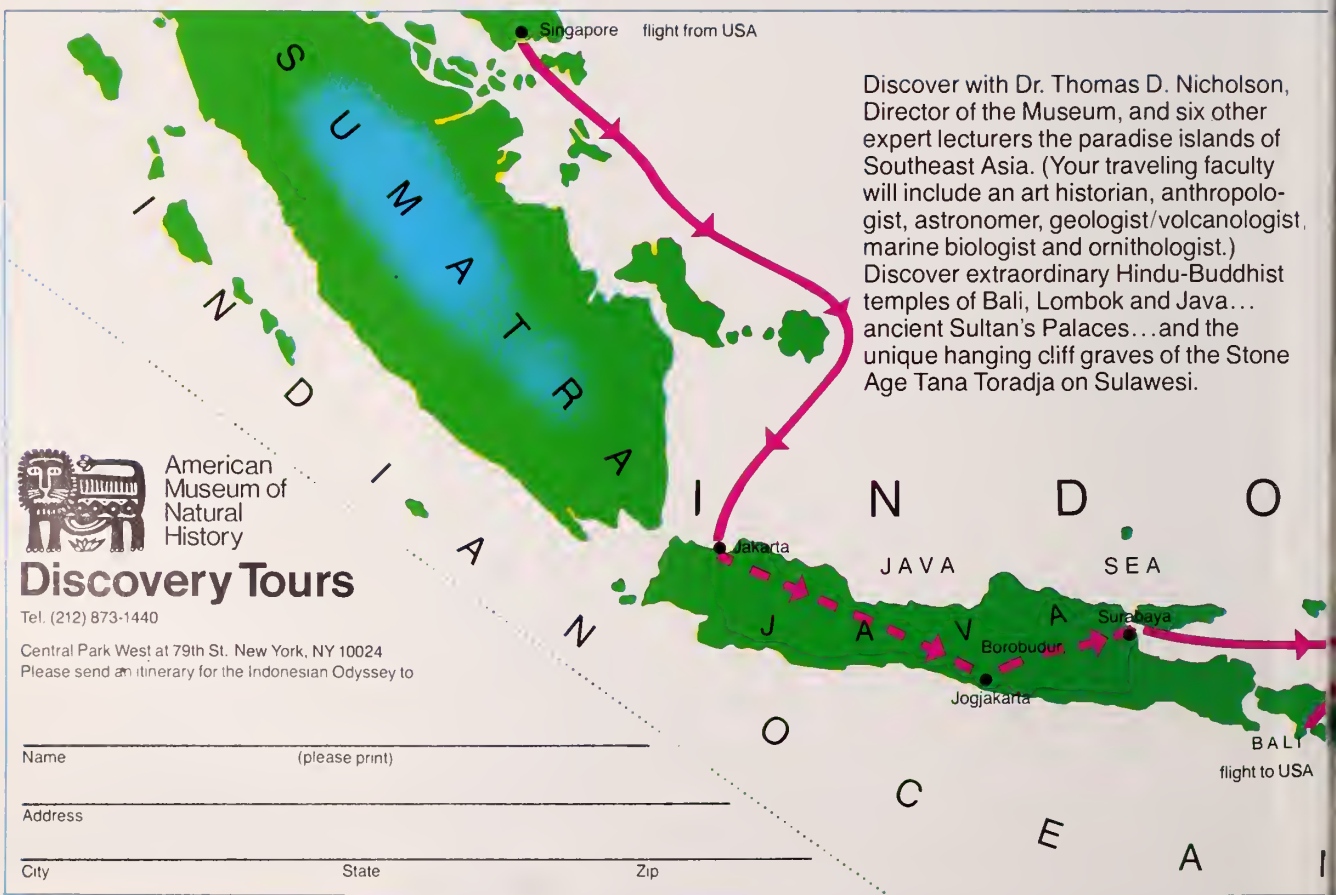
to the Arsenal Building in Central Park. In 1871 the Museum and its sister institution, the Metropolitan Museum of Art, jointly petitioned the state legislature for land and buildings to permanently house and display their expanding collections. The petition, signed by 40,000 prominent New Yorkers, was speedily accepted, and the city offered the Museum a patch of land—which was known at the time as Manhattan Square—adjacent to Central Park.

The Parks Department had been considering turning this tract into an extravagant zoological park, complete with bear pits and a museum of paleontological reconstructions. When The American Museum took it over, it was a dismal site, indeed. As Louis Gratacap, a curator in the young Museum, wrote:

> This region comprised eighteen acres which had been reserved for a park, years before the design of a Central Park was suggested. It included a rugged, disconsolate tract of ground, thrown into hillocks where the gneiss ledges protruded their weathered shapes, or depressed in hollows filled with stagnant pools, and bearing throughout an uncompromising, scarcely serviceable appearance.
>
> The elevated railroad did not then extend beyond 59th Street, the present bridge over the walled bridlepath into the Park was not yet built, and the Museum thus stood isolated both from the Park and from the populous city. The region around was compounded in its pictorial aspect of several discordant yet picturesque elements; it embraced old farms, ruinous landmarks of ancient New York, brand new stores, sanitary modern tenements, bewildering mazes of hovels clustered together over swelling knobs of rocky ledges, and pretty kitchen gardens lying in its deep depressions. The banks of the Hudson retained in places woods as old as New Amsterdam, and the daily stage which rolled up the spacious boulevard to Manhattanville added a suggestive touch of antiquity to all.

The first improvement to the site was the unceremonious eviction of the picturesque squatters with their goats and pigs. The trustees hired Calvert Vaux, one of the designers of Central Park, as the architect of the fledgling Museum. Vaux came up with a magnificent plan, calling for a building three times larger than the British Museum. According to a report submitted to the trustees, Vaux "contemplated for the entire edifice a hollow square whose sides were to be formed of four great buildings 700 feet long, ornate in material and detail, and distinguished by large entrances of architectural dignity and strength." The hollow square would contain two long buildings that crossed in the center, forming four courtyards. The center of the structure would have an enormous tower rising up to the heavens, which appropriately would contain the Hall of the Heavens. Jacob Wrey Mould, J.C. Cady, and other architects enlarged upon and embellished Vaux's plan.

On June 2, 1874, Pres. Ulysses S. Grant laid the cornerstone of the new building. He was attended by a flock of important officials, including three cabinet members, the governor, and the mayor. It must have been an odd sight, with the remaining squatters and livestock looking on as Grant troweled the cornerstone and time capsule into place (the trowel was stolen a few moments later, proof that the good old days of New York were not as



Discover with Dr. Thomas D. Nicholson, Director of the Museum, and six other expert lecturers the paradise islands of Southeast Asia. (Your traveling faculty will include an art historian, anthropologist, astronomer, geologist/volcanologist, marine biologist and ornithologist.) Discover extraordinary Hindu-Buddhist temples of Bali, Lombok and Java... ancient Sultan's Palaces...and the unique hanging cliff graves of the Stone Age Tana Toradja on Sulawesi.

American Museum of Natural History

Discovery Tours

Tel. (212) 873-1440

Central Park West at 79th St. New York, NY 10024

Please send an itinerary for the Indonesian Odyssey to

Name (please print)

Address

City State Zip

rosy as people imagine). One speaker alluded apologetically to the scene:

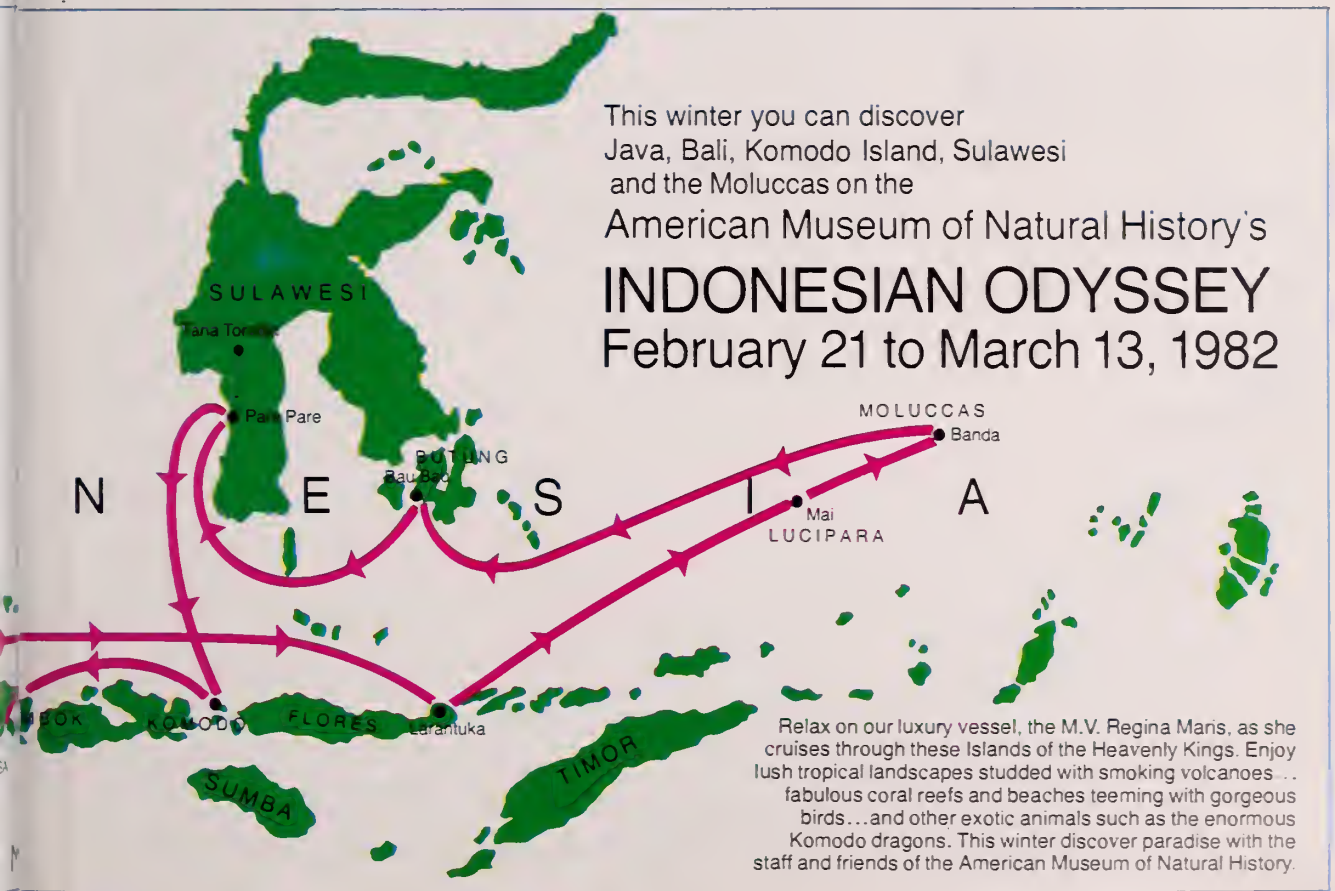
To the stranger who comes here today these rugged foundation walls and rough surroundings are not well calculated to make a pleasant impression; but to us . . . it requires but little strain upon the imagination to conceive the speedy occupation of all these vacant lots by substantial dwellings, and to picture to ourselves the spot on which we now stand, known as Manhattan Square, as covered by the proposed Museum of Natural History.

The first building opened to the public in 1878. It was an austere, Victorian Gothic structure that looked out upon a wasteland of rubble and undrained ponds. It was so far uptown that its exhibition halls had virtually no visitors, and at one point, the trustees actually considered closing the place. But better times were ahead, according to Gratacap:

The local isolation which had at first seemed discouraging was in the process of improvement. The Manhattan Elevated Railway pushed forward its tracks to 81st Street and on to Harlem, and brought Manhattan Square into practical union with all quarters of the city. An extraordinary movement northward was soon developed, and the ridges of rock, unpleasantly encumbered with shanties, were blasted to a level, and covered with houses. Centers of population were created, as in 72nd Street and the Dakota Apartments, Saint Agnes' Church at 94th Street with its surroundings, and the growing inhabitation of Riverside Drive. These, spreading, met along lengthening lines of contact, and a population was becoming localized directly at the doors of the Museum.

A Romanesque Revival façade designed by J.C. Cady was added to the Museum in 1889, and in 1893 the east wing was built. These greatly improved the Museum's appearance; in fact, the façade has often been called the finest example of Romanesque Revival architecture in the city. During the next fifteen years, the Museum continued to expand along the designs of Vaux and Mould. By 1899, the west wing, southeast corner wing, and southwest corner wing had been erected. The heating and lighting plant (a squat windowless cube) and a lecture hall were erected by 1903. In 1906 the south wing of the west façade was finished. When construction finally stalled, only one-third of Vaux's original building was complete. In particular, the all-important east façade facing Central Park had not been built, and the Museum started looking at various designs.

In 1911, two architects submitted a plan calling for "an entrance of monumental size" with a "broad and dignified avenue of approach." This idea bounced around for a while, but nothing came of it. Then, when Teddy Roosevelt died in 1919, the Museum decided to turn the east façade into a monument for him. The monument was to "interpret the character of Roosevelt as a naturalist and citizen" and "suggest a lofty standard of idealism through harmonious lines inspired by models chosen from the golden age of architecture." The Romanesque Revival style was abandoned and replaced by an architectural style that has become known as Roman Eclectic—"Roman" because it borrowed various bits and pieces from Roman and Greek models, and "Eclectic" because it borrowed indiscriminately. John Russell Pope, specialist in clas-



This winter you can discover
Java, Bali, Komodo Island, Sulawesi
and the Moluccas on the
American Museum of Natural History's
INDONESIAN ODYSSEY
February 21 to March 13, 1982

Relax on our luxury vessel, the M.V. Regina Maris, as she cruises through these Islands of the Heavenly Kings. Enjoy lush tropical landscapes studded with smoking volcanoes . . . fabulous coral reefs and beaches teeming with gorgeous birds . . . and other exotic animals such as the enormous Komodo dragons. This winter discover paradise with the staff and friends of the American Museum of Natural History.

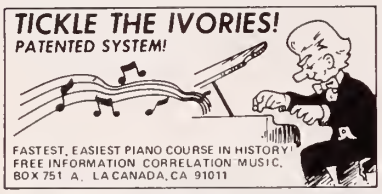
INDIA
&
AROUND THE WORLD
with
Nepal-Sri Lanka-Bhutan
Burma-Thailand

Journeyworld offers you the architectural splendors and unforgettable sights of some of the world's most creative civilisations. You will see the Taj Mahal, Kathmandu in the Himalayas, the stupendous rock carved temples of Ajanta & Ellora, Bhutan a fairy tale Buddhist kingdom, colorful Kandy in Sri Lanka, the glory of Pagan and Mandalay the elephant camps and tribal villages of Chieng Mai.
The programs include comprehensive sightseeing, deluxe hotels and all meals.

For information call or write.

JOURNEYWORLD
155 East 55th St., New York, N.Y. 10022
Tel (212) 752-8308

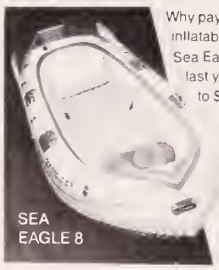
TICKLE THE IVORIES!
PATENTED SYSTEM!



FASTEST, EASIEST PIANO COURSE IN HISTORY!
FREE INFORMATION CORRELATION MUSIC,
BOX 751 A, LA CANADA, CA 91011

SEA EAGLE

The Quality Alternative
to High-Cost Inflatables



Why pay $600 or more for an inflatable boat?
Sea Eagles pack small, last years and cost $100 to $220. Canoes, dinghies and motormount boats. Write for **FREE** brochure

SEA EAGLE 8

Sea Eagle
Dept. NH7
St. James, NY 11780
phone 516-724-8900

WHEN YOU WRITE TO NATURAL HISTORY

about a subscription renewal, billing, or any kind of adjustment, please include your present address label.

Moving? Please notify 6 weeks in advance. Send your present address label along with your new address to Natural History Membership Services, Box 4300, Bergenfield, NJ 07621.

Name _____

New Address _____

_____

City _____ State _____ ZIP _____
Please Print **Attach Label**

sical architecture, designed the Doric-colonnaded façade and interior Memorial Hall (now erroneously called a rotunda). The sculptor James E. Fraser created a massive bronze statue of Roosevelt astride a horse and flanked by an American Indian and an African, symbolic of "Roosevelt's interest in the original peoples of these widely separated countries."

The design also called for a grand intermuseum pathway stretching across Central Park and linking the American Museum with the Metropolitan Museum. When this plan was rejected by the Parks Department, Henry Fairfield Osborn, president of the American Museum, scaled it down to an avenue 500 feet long and 160 feet wide. He fought long and hard for the idea, and was bitterly disappointed by his lack of success; later, he would refer to this as one of the great failures of his life. The memorial, however, was built, and today the statue of Roosevelt, thirty feet high, looks out over the park with dignity.

The Roosevelt Memorial—the last great addition to the Vaux-Mould plan—opened in 1936. During the last half century, all new buildings not called for in the original plan have been constructed in the spaces allocated for courtyards so as to leave room for the completion of the design. These new buildings include the Hayden Planetarium and many other structures of varying degrees of architectural merit. The Museum's entire exterior—including its sheds, storage buildings, and power plant—was designated a National Landmark by the city in 1967. No one knows if this designation includes the incinerator, sawdust chute, and garbage bins tucked away behind the magnificent pink granite façades of the Museum. The original Victorian Gothic building is almost invisible from the outside, and from the inside one can only glimpse its austere structure. Its cornerstone and time capsule, so carefully troweled in place by President Grant, were lost for nearly a century; their location was only rediscovered in 1969 after a diligent search occasioned by the Museum's centennial.

Today, the original plan of the Museum—that of a huge square with an interior cross—is about 60 percent complete. But the dream of one day finishing the plan, essentially Vaux's, but with new architectural styles, is still very much alive.

Douglas J. Preston

Art/Crafts

A COAT OF ARMS is the timeless Jewel of those who value heritage! Write. Athol Heraldry, Box 9N, Athol, MA 01331

AMERICAN INDIAN CRAFTS: Pueblo pottery; Hopi 2nd and 3rd Mesa plaques; Kachinas; old and new rugs. No catalogue. One-of-a-kind pieces; individually photographed. Most priced $100/up. Write for photos and data, specifying interests. Box 5896, Sherman Oaks, CA 91413 (213) 789-2559

APPALACHIAN HANDCRAFTS, FOLKART: Baskets, quilts, rugs, brooms, more. Catalogue $1.50. Appalachia, 340N Village Lane, Los Gatos, CA 95030

COLORFUL MARU MASK, Sri Lanka, 12", wood, $33, request photo, McCoy Imports, Liberty, NY 12754

FREE! COLOR BROCHURE, Large National Park Prints by M. Woodbridge Williams, Photo Classics, Dickerson, Maryland 20753

HANDCRAFTS OF PAPUA NEW GUINEA, Carvings, Masks, Bows and Arrows, String Bags. Send $5 for Photo catalogue, shipping and price information. ROKU, Box 5045, Boroko, Papua New Guinea

WHALES of hand-carved pine. Illustrated brochure $1.00. Doug Lind, P.O. Box 74, Burlington, WI 53105

WILDLIFE SCULPTURE—Custom made for you of your favorite animal. Send details for estimate to St. Renz, 1299 Palmer Avenue, Larchmont, NY 10538 (914) 834-9419

Book Publishers

PUBLISH YOUR BOOK! Join our successful authors. Publicity, advertising, beautiful books. All subjects invited. Send for fact-filled booklet and free manuscript report. Carlton Press, Dept. NHG, 84 Fifth Avenue, New York 10011

Books

BOOKFINDING. Librarians search worldwide titles or subjects plus 150,000 indexed stock. PAB, 2918 Atlantic, Atlantic City, NJ 08401 (609) 344-1943

PUBLISHERS' OVERSTOCKS, BARGAIN BOOKS. 2,000 titles, all subjects! Free catalogue: Hamilton, 98-55 Clapboard, Danbury, CT 06810

Business Opportunities

ENTREPRENEURS WANTED! Former Shaklee President Announces New Opportunity. Nature Oriented. Free Details! (612) 588-1957, Enhance, Box 22726H, Robbinsdale, Minnesota 55422

Correspondence

"EARTH FRIENDS" magazine interconnects outdoors and nature lovers USA/worldwide for conservation networking, friendship, adventure. Box 331499N, Miami, FL 33133

MAKE FRIENDS WORLDWIDE through international correspondence. Illustrated brochure free! Hermes-Verlag, Box 110660/NH, D-1000 Berlin 11, West Germany

ORIENTAL WOMEN SEEK CORRESPONDENCE for cultural exchange, language practice, friendship. Asian Exchange, Honokaa, Hawaii 96727

Education

EXPLORE MICROSCOPIC WORLD—algae, protozoans, blood cells, etc. New Science Course for all ages. How to purchase and use a microscope with free brochure. Life Sciences, Box 591K, Woodbury, NJ 08096

THE MARKET

Employment Opportunities

AUSTRALIA NEEDS YOU! Jobs! Paid Transportation! Newest handbook, $2.00 (guaranteed). Australian International Services, Box 19107-RU, Washington, DC 20036

AUSTRALIA . NEW ZEALAND WANT YOU! 17,500 Jobs! Paid Transportation! New Report! $2—Money-back Guarantee! "Australia Commission," Department 894-C7, National Press Building, Washington, DC 20045

OVERSEAS—ALL OCCUPATIONS! Worldwide Directory and complete information—$3.00. International Opportunities, Box 19107-RT, Washington, DC 20036

ROCKY MOUNTAIN EMPLOYMENT NEWSLETTER! Colorado, Idaho, Montana, Wyoming! Current openings—all occupations! Free details . . . Intermountain-4Y, 3506 Birch, Cheyenne, WY 82001

Foreign Newspapers

WORLDWIDE ENGLISH NEWSPAPERS. 65 countries including Australia! Sampler 5/$2.98. Free Brochure. Multinewspapers, Box DE-207, Dana Point, CA 92629

Gourmet Interests

HAWAIIAN ORGANIC DRIED Papayas, Bananas, Fish and Poi. $3.88 per four ounce package, plus $1.63 postage and handling. Kapunalele Trading, Rt. Hon. Olmsted Hay, Private Bag KK, Kekaha, HI 96752 (808) 335-3877

PASTA RECIPE, authentic from Naples. $1.00! SASE Williams, 590 1st Avenue, Apt. 4, Rochelle, IL 61068

WHOLEGRAIN COOKIE RECIPES. 2 wholegrain/honey originals. $1.00 SASE, Donnelly, 11 Elizabeth St., Worcester, MA 01604

Government Surplus

"GOVERNMENT SURPLUS DIRECTORY." Buy 500,000 items (including Jeeps) . . . low as 2¢ on dollar! Most complete information available-$2.00. Surplus Disposal, Box 19107-RT, Washington, DC 20036

JEEPS—$19.30!—CARS—$13.50!—650,000 Items! —Government Surplus—Most Comprehensive Directory Available Tells How, Where To Buy—Your Area—$2—Moneyback Guarantee—"Government Information Services," Dept. DC-7, Box 99249, San Francisco, CA 94109

Miscellaneous

BECOME SELF-SUFFICIENT. Food production, storage, family preparedness. $6.00 for detailed program. AEI Corporation, Box 107(D), Nappanee, IN 46550. Phone (219) 773-2673

IDEAS, INVENTIONS, new products wanted! Write for Kit-NH, IMI, 701 Smithfield Street, Pittsburgh, PA 15222

Music

BUILD YOUR OWN INSTRUMENT! Free kit catalogue, constructing dulcimers, mandolins, guitars, even harps, lutes & harpsichords. Hughes Dulcimers, 4419 West Colfax NH2, Denver, CO 80204

RECORDS—TAPES! Discounts to 75%; all labels; no purchase obligations; newsletter; discount dividend certificates; 100% guarantees. Free details. Discount Music Club, 650 Main St., Dept. 25-0781 New Rochelle, NY 10801

Old Time Radio

OLD TIME RADIO PROGRAMS on cassette tapes. Free catalogue. Cassette Library Center, P.O. Box 5331H, Baltimore, MD 21209

Optics

BINOCULAR SALES AND SERVICE. Repairing binoculars since 1923. Alignment performed on our U.S. Navy collimator. Free catalogue and our article "Know Your Binoculars," published in Audubon Magazine. Mirakel Optical Co., Inc., 331 Mansion St., West Coxsackie, NY 12192 (518) 731-2610

LEITZ, ZEISS, B&L, SWIFT, BUSHNELL, NIKON, Optolyth binoculars, telescopes and accessories. Send stamp for discount list. Specify literature desired. Large stock. Orders filled postpaid day received. Birding, Box 5N, Amsterdam, NY 12010

OPTIC DISCOUNTS: Binoculars—Telescopes—Brand Names—Free Catalogue. Thos. Manetta, 61 Hoffman Avenue, Elmont, NY 11003

Photography

CLOSE-UP PHOTOGRAPHY IS MUCH EASIER now with slide rule calculator, The Macro Factor. Gives exact subject-flash distance without using formulas, charts, or computations—to 9×. $10.95 postpaid. Photographic Reflections, Box 13018(NH), St. Louis, MO 63119

"PHOTOGRAPHY IS A VISUAL FEAST." An extremely clear book on taking and developing your own pictures. Send $6.95 to Box 875, Mendocino, CA 95460

THE FLYING EAGLE®. Finest laser color reproductions of the ultimate Bald Eagle photograph. 16 × 20 Fine Art Print, $20. Kenneth R. Hunter, Ph.D., Egegik, Alaska 99579

Real Estate

CANADIAN ADVENTURER LAND. Sandy beaches, tall pines. For family fun, fishing, boating. Airstrip. $2,700.00 for surveyed lot. $35.00 monthly or $2,200.00 cash. Write: Canadian Lakeshore Estates, Dept. NH, P.O. Box 963, Kingston, Ontario K7L 4X8

FREE! Big Summer Catalogue! Over 5,400 country properties described, pictured! Land, Farms, Homes, Businesses, Waterfront, Recreation, Retirement buys! Selected best thruout the U.S. Over 700 offices, 43 states. All Across America! Yours Free from the World's Largest! Strout Realty, Inc., 60 E. 42nd Street, Dept. 5390, New York, NY 10017

FREE . . . 296-PAGE CATALOGUE. Describes and pictures over 2,800 farms, ranches, acreages, businesses and town and country homes from coast to coast. United Farm Agency, Inc., 612-V W. 47th St., Kansas City, MO 64112. Ph. Toll-Free: 1-800-821-2599; MO. Res. Ph. Toll-Free: 1-800-892-5785

GOVERNMENT LANDS FROM $7.50/ACRE! Homesites, farming, vacationing, investment! "Land Buyer's Guide" plus nationwide listings—$2.00. Surplus Lands, Box 19107-RT, Washington, DC 20036

Resorts

VACATION/RELAXATION—Birdwatcher's delight—Peaceful, secluded nature lover's mountain retreat. Cave Creek Ranch, Portal, Arizona 85632

Tours/Trips

ADVENTURES IN AFRICA and everywhere. Gorilla photo-safari through Rwanda and Zaire. Camping in Tanzania's Serengeti. Ecology safari in Parks and remote aras of Kenya. Over 25 wildlife trips including India, Nepal, Galapagos, Mexico, Hawaii & Alaska. Birding trips in Arizona, Ecuador, Africa. Photograph mountain gorillas, polar bears, asian rhinos, rare birds. Small groups with expert leaders. Adventures International, 4421-N Albert St., Oakland, CA 94619

AFRICA. Before your safari read Norman Carr's VALLEY OF THE ELEPHANTS. $14.00 plus $1.00 handling. Nordic Enterprises, 327 West 55th St., NYC 10019

ALASKA TRAVEL ADVENTURES—Experience Alaska in guided intimate group trips. Backpacking, canoeing, kayaking, whitewater rafting, wildlife photography, fishing, custom trips. Alaska-Hawaii Combinations. Free catalogue describes 50 different trips throughout Alaska for all ages and abilities. Contact Alaska Travel Adventures, 499 Hamilton Ave., Suite 212-NH, Palo Alto, CA 94301. In California call collect (415) 329-9013, elsewhere toll free (800) 227-8480

ALASKAN WATER ADVENTURES. Kayaking, Rafting, Birding in Prince William Sound and Copper River Basin. Open Door, Box 1185N, Cordova, Alaska 99574 (907) 424-7466

BIRDING WITH THE POINT REYES BIRD Observatory. We specialize in small, professionally-led, economically priced birding and natural history excursions in the Western US, Mexico, and Central America. Write: PRBO—Natural Excursions, 4990 Shoreline Hwy., Stinson Beach, CA 94970

CHRISTMAS ISLAND—Going to Hawaii? Then visit Christmas Island too, one of the ultimate destinations for every birder. For details, write Nature Travel Service, 6372 Montrose Rd., Niagara Falls, Ontario L2H 1L6 Canada

HIMALAYAN TRAVEL, INC. Trekking expeditions in the Everest and Annapurna areas of Nepal. Exotic cultures/spectacular mountain scenery. Box 481-NH, Greenwich, CT 06830 Toll Free (800) 243-5330

JERSEY PINE BARRENS. Naturalist guided canoe and backpack adventures. Pineland Voyageurs, Box 453, Willingboro, NJ 08046

NATURALIST GUIDED FIELD SEMINARS and tours. West Texas and Mexico. Rafting, hiking, backpacking, bus. University or Continuing Education credit as appropriate. Write Education Department, Chihuahuan Desert Research Institute, Box 1334, Alpine, TX 79830

NEW ZEALAND WALKABOUT. A selection of escorted nature and hiking tours, featuring New Zealand's scenic National Parks, the Milford Track, Farm Holiday Stay. Pacific Exploration Company, Box 3042-N, Santa Barbara, California 93105

PINE BARRENS natural history canoe trip, 2 days, $100. Blue Sky Adventures, Dept. NH6, Oak Ridge, NJ 07438

RED SEA DIVING TOUR, OCT. 16-30. Nine days diving Sinai. Underwater Photo Course. Two nights Jerusalem guided tour. Professional diver, photographer escort. Limited, small group. Aquaventure, Box 237, Waitsfield, VT 05673 (802) 583-3158

SAILING SCHOOL-SEASON 1981-1982. Seamanship and Navigation courses aboard 50′ ketch 'Palisander'-Chesapeake Bay and Caribbean, also Blue Water Passages between. Cuttyhunk Marine Adventures, Gwynn, VA 23066

SAVE ON LUXURY CRUISES! (Passenger ship or Freighter) How? Ask TravLtips, 163-09 Depot Road, B517, Flushing, NY 11358

VISIT THE GALAPAGOS ISLAND LEISURELY designing your own expedition with the De Roy family's 33 ft. sailboat. Capacity 4 passengers, multi-lingual naturalist. For information write: Gil De Roy, Isla Santa Cruz, Galapagos, Ecuador

WHALE RESEARCH EXPEDITION, Cape Cod, September 17-20, $100. New Jersey Audubon Society, Dept. NH, 790 Ewing Avenue, Franklin Lakes, NJ 07417

INDIA. WHERE THE WORD IS WORTH A THOUSAND PICTURES.



Visit the Taj



Our people are warm and friendly



Make a houseboat your hotel



Stay in a modern hotel



The last of the Bengal tigers



Live in a Maharajah's lake palace

Ancient temples.
Peacocks roosting in mango trees.
Colorful bazaars bustling with people.
India will fill your life with pictures. Pictures that will last forever.
In India you can trek on rugged mountain trails, do yoga on a fabulous beach, meet holy men.
You can stay in great hotels, or float in your own houseboat.
Whatever you'd like, we have. Wildlife. Art, music and dance.
Enchanting festivals and fairs.
And more.
Come visit us. There are lots of tours to our country. Your travel agent will tell you about them.
Or send us the coupon and we will.

UNBELIEVABLE INDIA

Please send me information on Unbelievable India. NH-7

Name

Address

City

State. Zip

GOVERNMENT OF INDIA TOURIST OFFICE
30 ROCKEFELLER PLAZA. NEW YORK. N.Y. 10112 (212) 586-4901. 3550 WILSHIRE BLVD. LOS ANGELES. CA. 90010 (213) 380-8855
230 N. MICHIGAN AVE. CHICAGO. IL. 60601 (312) 236-6899 POST BOX 342 T.D. CENTRE TORONTO. CANADA (416) 362-3188
MIAMI. FLA. (305) 944-7039. DALLAS. TEXAS (214) 234 2233. SAN FRANCISCO. CA. (415) 564-2973

Stomatopods (p. 36)

More than half of the sixty-two different species of mantis shrimps described in R.B. Manning's *Stomatopod Crustacea of the Western Atlantic* (Coral Gables: University of Miami Press, 1969) were unknown in the western Atlantic fauna prior to this study. Part of the "Studies in Tropical Oceanography" series, this primary research work summarizes existing knowledge of the region's stomatopods, including distribution records, and contains a bibliography (pp. 350–71). "Geographic Range, Life History Patterns, and Body Size in a Guild of Coral-dwelling Mantis Shrimp," by M.L. Reaka (*Evolution*, vol. 34, pp. 1019–30), examines the relationship between body size and extent of geographical range in coral-dwelling stomatopods. Based on studies of their life history traits and on observation of catastrophic disturbance in shallow coral habitats, the author concludes that large species of hole-dwelling mantis shrimps disperse more widely and are relatively more opportunistic colonizers than small species. Reaka analyzes the ecological and evolutionary consequences of molting in mantis shrimps in "Lunar and Tidal Periodicity of Molting and Reproduction in Stomatopod Crustacea: A Selfish Herd Hypothesis" (*The Biological Bulletin,* vol. 150, pp. 468–90); she investigates stomatopod learning ability and its relationship to behavior in her recent "On Learning and Living in Holes by Mantis Shrimp" (*Animal Behaviour*, vol. 28, pp. 111–15). An illustrated overview of these shrimp-like creatures is R.L. Caldwell and H. Dingle's "Stomatopods" (*Scientific American*, January 1976, pp. 80–89), which includes information on predatory behavior, threat displays, attacks, and competitive ability. Other useful articles by Caldwell and Dingle include "The Aggressive and Territorial Behavior of the Mantis Shrimp *Gonodactylus bredini* Manning (Crustacea: Stomatopoda)" in *Behavior* (vol. 33,

pp.115–36) and "Reproductive and Maternal Behavior of the Mantis Shrimp *Gonodactylus bredini* Manning (Crustacea: Stomatopoda)" in *The Biological Bulletin* (vol. 142, pp. 417–28).

Andean Birds (p. 50)

For a more technical approach to high Andean birds than that found in this issue, see F. Vuilleumier and D. Simberloff's "Ecology Versus History as Determinants of Patchy and Insular Distribution in High Andean Birds" (*Evolutionary Biology*, vol. 12, pp. 235–379). J. Dorst's natural history of *South America and Central America* (New York: Random House, 1967) discusses the landscape, plants, and animals of those areas, and has interesting sections on the high Andes. *Land Above the Andes*, by T. Morrison (New York: Universe Books, 1972), a popular account of wildlife in that mountain range, contains much interesting material on the high Andes, but is flawed by inaccuracies. An excellent field guide to the birds of central Peru, *The Birds of the Department of Lima, Peru*, by M. Koepcke (Wynnewood: Livingston Publishing Co., 1970), includes most of the birds from the high Andes discussed in this issue's article. Useful as reference works are R.M. de Schauensee's *The Species of Birds in South America and Their Distribution* (Neberth: Livingston Publishing Co., 1966), which lists the bird species inhabiting that continent, and *A Guide to the Birds of South America* (Wynnewood: Livingston Publishing Co., 1970), an illustrated manual appropriate for amateurs as well as ornithologists. De Schauensee and W.H. Phelps, Jr., coauthored *A Guide to the Birds of Venezuela*, illustrated by G. Tudor (Princeton: Princeton University Press, 1978), a field guide providing essential information on the physical characteristics, behavior, habitat and range of Venezuela's diverse and plentiful avifauna, comprising nearly 1,300 species.

Rita Campon

Multi-Purpose

MUSHROOM CALENDAR

by Orson K. Miller and David L. Largent

- A **calendar** with large spaces for memos
- An **identification guide** to common edible mushrooms
- A collection of beautiful **color photographs** of mushrooms
- A collection of **recipes** using wild mushrooms

First in a series of unique calendars to be published annually.

Calendar will remain useful at the end of the year: the recipes can be cut out and stored, the photographs can be framed for hanging or otherwise be used as decorations, the recipes and photographs can be removed to start a book on edible mushrooms.

An excellent and unusual gift; a mailer is available.

Now at a special prepublication price. Offer expires Sept. 1, 1981

All prices include postage and handling.

$5.95 (without mailer)
$6.95 (with mailer)
Regular price
$8.80 and $9.95, respectively.
Calif. residents add 6%.

Send check or money order to

MAD RIVER PRESS-Dept. NHM
Rt. 2, Box 151-B
Eureka, CA 95501



Multi-Purpose

MUSHROOM CALENDAR

A Fish Story

The salmon's decline in the Pacific Northwest is a tale with many villains and few heroes

by Raymond Sokolov

The best fish story I know revolves around a Finnish-American woman called Vanessa and an extremely large salmon. Some years ago, Vanessa was spending a weekend with a friend in Cooperstown, New York. The salmon arrived the same weekend, brought from Alaska by a neighboring plutocrat. Vanessa's host heard about the majestic fish and knew that it was languishing in the refrigerator of its owner, whose culinary ineptitude was local legend. Vanessa, a cook of skill and daring, resolved to liberate the noble salmon and give it fitting gastronomic treatment. Seizing a moment when the plutocrat and his family were busy at tennis, she crept into the house, purloined the *Oncorhynchus*, and poached it to a turn in her host's kitchen. She boned and glazed the fish and returned it to the owner's refrigerator.

In fact, Vanessa only returned half the salmon and kept the other half for the delectation of herself and her friends. It seemed only fair, in light of the service rendered. And when the rightful owner saw the beautifully decorated, flaky, pink chaudfroid salmon ready to eat in his fridge, he was delighted.

Not all the salmon stories have such happy endings. The Pacific Northwest, once a salmon paradise, is today a region made glum and angry by the salmon's decline. As an outsider, I want to speak with caution about Pacific salmon. It is a most complicated subject. Ask almost anyone in Washington State about salmon and the usual reply is a shake of the head, because the salmon question has as many sides as a sockeye has scales.

Consumers blame industrial polluters. Environmentalists lambaste the power companies that built the dams that block the rivers and impede salmon from making their way upstream to spawn. Non-Indian fishermen bristle over the federal court ruling that compels them to share the shrinking salmon catch with Indian fishermen on a strictly equal basis. But the Indians, prospering materially because of this judicial interpretation of their treaty rights, will still probably never regain the salmon-centered way of life they led before the coming of the white man.

Northwest Coast Indians had some 9,000 years in which to perfect an intricate salmon-catching technology, a salmon cuisine, and various rituals celebrating the importance of salmon in their culture. Hilary Stewart's exhaustive *Indian Fishing: Early Methods on the Northwest Coast* (University of Washington Press) is a fascinating encyclopedia of salmon lore that shows, for example, exactly how to make bentwood hooks and how the Nootka tribe trolled for salmon in open water just before the run. Stone sinkers, bone barbs, spruce-root lashings, leaders of human hair or doeskin or cedar bark twine—all these natural materials were combined laboriously, baited with fish caught in small stone dams, and run out on a long line. The fisherman fastened the line to his paddle handle so that he could locomote and make his baited hook move at the same time.

Other fishermen used harpoons or gaff hooks carved from antlers and elaborate nets made of willow-bark twine or homespun nettle fiber. In rivers, they could intercept running salmon with traps and weirs.

Indian salmon cookery was also a sophisticated business. Watertight boxes and baskets were filled with water; then hot stones from a campfire were added with tongs. After the stones made the water boil, in went pieces of salmon in an openwork basket.

Lacking metal ovens, the Indians dug steam pits in the ground or cooked split salmon over heated rocks, methods very close to the East Coast clambake.

The simplest and most famous method of salmon cookery in the Pacific Northwest was to roast the fish over a wood fire. Split salmon were held flat on roasting tongs or skewered on crossed sticks. The tongs and sticks had sharp ends so that they could be stuck in the ground at the edge of the fire. The whole apparatus was tilted slightly, and the salmon extended over the heat. First one side of the fish was roasted, then the other.

Traditional Indian salmon roasting continues to be practiced widely in Washington. The alderwood typically used in the process imparts a superb flavor to the fish, as I can attest, having tasted some that had been cooked over alder chips on a not-so-picturesque but effective metal grill at an open-air takeout counter in Seattle.

Roast salmon was much more than a gourmet treat for Northwest Coast Indians in the old days. Rivers clogged

Photographs by Adelaide de Menil







with salmon were a guarantee of survival all through the year. But like all staple food sources, salmon had to be stored and preserved for the months when fresh salmon wasn't available. Without refrigerator-freezers, Indians built large smokehouses and drying racks and perfected the arts of drying and smoking salmon to a high level. Some fish were half smoked, for immediate eating. That way the flesh was still soft. Other fish were fully dehydrated by longer smoking so that they would keep through the winter.

On a recent visit to Lummi Island, a settlement in the north part of Puget Sound accessible by ferry, I bought some of this "hard-smoked" salmon, which had been prepared by Lummi Indians. It resembled beef jerky in its tough, brittle texture and salty taste. During the drive back south to Seattle, which was frequently whited out by a freak fall blizzard, I understood graphically how earlier generations of Lummis and their coastal neighbors had found this preserved fish a handsome and convenient protein source in cold weather.

Left: Split salmon, skewered on crossed sticks that hold them flat, are roasted over a wood fire. Below: Salmon are hung in a smokehouse to preserve them.

Necessity taught the Indians to eat every part of the salmon—from cheeks to spine. Even salmon roe were hung in strips and dried or smoked. Some Indians put roe in bags made from deer stomachs and hung the bags in their smokehouses. Each day they would knead the bag until the moisture evaporated and the eggs turned into a kind of cheese. Another route to the same result involved burying the roe in a three-foot pit lined thickly with maple leaves. Holes poked in the leaves at the bottom of the pit allowed oil to drain away. After two months, the eggs turned to cheese and could be eaten plain or boiled with water for soup. Some Indians preserved salmon roe by leaving it to cure in saltwater.

None of this salmon-based economy could have occurred without the seemingly supernatural, superabundant annual return of the fish from saltwater to freshwater. Each year, grateful and awe-struck Indians greeted the arrival of the first salmon with joyful celebration and a variety of ritual observances.

When a Kwakiutl troller caught his first nine salmon, he clubbed them only once, stunning but not killing them. Then he strung them on a twisted cedar withe, tied it in a hoop, put the hoop around his neck, and prayed: "I do not wish to club to death your souls so that you may go home to the place you came from, Supernatural Ones. . . ."

After eating the first salmon of the



season, the family wiped their hands on cedar bark but did not wash them. Any bones and leftovers were thrown into the sea, along with the new mats used as a table, to insure a repetition of the run the following year.

These days, no one practices these rituals, but the Indians of our Northwest Coast have found new ways to foster and control the life cycle of the salmon. The Lummis, for example, manage a modern program of aquaculture. And like other Indians in the area, they have benefited from a federal court decision handed down by Judge George H. Boldt in 1974. Boldt ruled that treaties between Indians and the federal government signed in 1854, which guaranteed Indians the right to fish "in common" with non-Indian fishermen, had in fact reserved 50 percent of the catch to the tribal signatories.

Overnight, the relatively small tribal fishing fleet, which before the decision had only been able to catch 10 percent of the commercial salmon in the area, now had a positive right to half. Higher courts have upheld Boldt, and today salmon fishing in Puget Sound is so strictly regulated that every salmon caught must be officially tagged as Indian or non-Indian. Since there are fewer Indian fishermen than white, the season for Indians is substantially longer. To maintain as fair a balance as possible, careful records of the progress of the catch are stored in a computer at the University of Washington. The Boldt decision also secured Indians an equal role in the administration of the new regulations, and at the fishery school on Lummi Island, Lummis are learning to run computer terminals that have access to the salmon records at the university. They are also learning other dry-land skills that will help them play a complete role in the brave new world of equal salmon opportunity. But even Indians suddenly in full enjoyment of their treaty rights must face the fundamental problem of exploiting a fragile and diminished fish population with intelligence. Even if they approach each year's run with their traditional reverence and spirituality, they can never restore the balance of supply and demand that once obtained on the precolonial, sparsely populated shores of Puget Sound.

Raymond Sokolov, a writer with an interest in the history and preparation of food, is editor of Book Digest.



Two Recipes from *The Market Notebook,* a collection of recipes from the Pike Place Market in Seattle, compiled by Pamela Sovold, Margaret Wherrette, and Eilisha Dermont (Madrona Publishers, Seattle)

Baked Salmon with Vegetables

The fish is covered with a thick layer of vegetables and baked in tightly closed foil (really steamed). Good straight from the oven, it is even better the next day, served cold.

Buy a whole fish and have your fishmonger book-fillet it, leaving in the backbone. To book-fillet means to cut the fish in such a way that the fish opens like a book on both sides of the spine. In this recipe the combination of the backbone and the wine makes an amber gelatin that sets when refrigerated and tastes sensational. Serve the fish and gelatin with fresh mayonnaise. Superb!

To prepare, mix together chopped celery tops, chopped onion, minced garlic, chopped green and red peppers, parsley, and jalapeño pepper. How much of each ingredient depends on the size of your fish; you want to put a one-half inch covering on it. Lay your fish on a large piece of foil in a baking pan. Cover with the chopped vegetables. Squeeze the juice of one lemon over the top and sprinkle with a tablespoon each of dillweed and sweet basil. Top with one-half cup of white wine. Seal the foil tightly. Bake at 375 degrees until fish flakes.

Fish with Rhubarb Sauce

- 2 cups rhubarb, cut in small pieces
- ½ cup tomato sauce
- 3 tablespoons olive oil
- 2 teaspoons sugar
- ½ cup water
- Salt
- 1 pound salmon, cut in pieces

Wash rhubarb well. Peel off hard skin, if any. Cook all ingredients (except fish) together for about thirty minutes. When rhubarb is cooked thoroughly, add cut up pieces of fish and simmer until fish is done.

Yield: 3–4 servings



JETTA: THE GREATEST COLLECTION OF VOLKSWAGENS EVER ASSEMBLED UNDER ONE ROOF.

Want us to run that by again? It's really not as crazy as it sounds. Because the Jetta just happens to combine the best features of every other Volkswagen we make.

On the road, for example, the Jetta handles like a Scirocco.

Which is only natural.

Since the Jetta is like a Scirocco.

With rack-and-pinion steering, front-wheel drive, independent 4-wheel suspension and a powerful CIS fuel-injected engine.

Inside, the Jetta is like our elegant Dasher.

With a luxurious amount of room, and a surprising amount of luxury.

And at the gas pump?

You guessed it.

The Jetta's like a Rabbit.

In fact, it gets an EPA estimated 25 mpg, 40 mpg highway estimate. (Use "estimated mpg" for comparisons. Your mileage may vary with weather, speed and trip length. Actual highway mileage will probably be less.)

Of course, the best thing about the Jetta isn't only that it's like a Scirocco, a Dasher or a Rabbit. The best thing about a Jetta is that it's also like, well, a Jetta.

With sleek European styling, sophisticated German engineering, and a trunk so well designed it can easily hold eight suitcases.

When you consider everything a Jetta has to offer, it's no wonder so many people are adding one to their car collections.

After all, how often can you acquire an entire collection in one car?

ALL OUR BEST IDEAS IN ONE CAR. JETTA.

© 1981 VOLKSWAGEN OF AMERICA

hexa·photo·cybernetic
The Possibilities are Endless.



Six-mode exposure control.
System versatility. Newer electronics for wider applications.



The Canon A-1 is one of the world's most advanced automatic SLR cameras. Combining the finest in optical and mechanical engineering with the most sophisticated electronics, it's technology applied to give you the ultimate in creative control. At the touch of a button.

Depending on your subject, you can choose from six independent exposure modes to achieve the results you want:

1 Shutter-Priority: You select the shutter speed, to freeze the action and prevent camera shake or create an intentional blur. The A-1 automatically selects the appropriate lens opening.

2 Aperture-Priority: Control the area in focus by selecting the lens opening for the effect you want. The A-1 matches with the right speed.

3 Programmed: When you need to shoot fast, just focus. The A-1 will select *both speed and aperture* for great results.

4 Stopped-Down: For extreme close-up or specialized photography, a bellows, a microscope or almost anything can be attached to the A-1. It's still automatic.

5 Flash: Totally automatic flash photography, of course, with a wide variety of Canon Speedlites to choose from.

6 Manual: Yes. For those times when you absolutely want to do it all yourself. To experiment. To explore the possibilities.



Programmed 350 95



There are over forty fine Canon lenses ranging from Fish Eye to Super Telephoto, plus accessories to meet every need. If you can't photograph your subject with a Canon A-1, it probably can't be photographed.

From the sophistication of its LED viewfinder display, to a ruggedness that allows up to five-frame-per-second motor drive, the Canon A-1 represents an incredible technology. At a price that makes owning one a definite possibility

Canon® A-1

Canon USA, Inc., One Canon Plaza, Lake Success, New York 11042 · 140 Industrial Drive, Elmhurst, Illinois 60126 · 6380 Peachtree Industrial Blvd., Norcross, Georgia 30071 · 123 Paularino Avenue East, Costa Mesa, California 92626 · Bldg. B-2, 1050 Ala Moana Blvd., Honolulu, Hawaii 96814 · Canon Optics & Business Machines Canada, Ltd., Ontario

© 1980 Canon U.S.A., Inc.

5.06(747)M1
Ref

NATURAL HISTORY



8/81



HOW THE NEW *Cimarron* BEATS THE IMPORTS AT THEIR OWN GAME.

	CIMARRON	AUDI 5000	BMW 320i	VOLVO GLE	SAAB 900S SEDAN
EPA MILEAGE RATINGS WITH STD. TRANS. HWY. EST./ EPA EST. MPG*	42/26	33/19	36/25	25/16	33/21
FRONT-WHEEL DRIVE	STANDARD	STANDARD	NOT AVAILABLE	NOT AVAILABLE	STANDARD
POWER-ASSISTED RACK AND PINION STEERING	STANDARD	STANDARD	RACK AND PINION ONLY	STANDARD	STANDARD
FOUR-SPEED MANUAL INCLUDING OVERDRIVE	STANDARD	STANDARD 5-SPEED	STANDARD 5-SPEED	STANDARD	STANDARD 5-SPEED
TACHOMETER	STANDARD	EXTRA COST	STANDARD	STANDARD	STANDARD
EPA PASSENGER COMPARTMENT VOLUME	89 CU. FT.	90 CU. FT.	82 CU. FT.	89 CU. FT.	89 CU. FT.
ALUMINUM ALLOY WHEELS	STANDARD	EXTRA COST	EXTRA COST	STANDARD	STANDARD
AIR CONDITIONING	STANDARD	EXTRA COST	EXTRA COST	STANDARD	DEALER INSTALLED OPTION
LEATHER-WRAPPED STEERING WHEEL	STANDARD	NOT AVAILABLE	EXTRA COST	DEALER INSTALLED OPTION	NOT AVAILABLE
LEATHER SEATING AREAS	STANDARD	EXTRA COST	NOT AVAILABLE	STANDARD	NOT AVAILABLE
MSRP**	$12,131 (F.O.B.)	$11,240 (P.O.E.)	$13,105 (P.O.E.)	$14,850 (P.O.E.)	$12,700 (P.O.E.)

*Use estimated mpg for comparison. Your mileage may differ depending on speed, distence, weather. Actual highway mileage lower. Cadillacs are equipped with GM-built engines produced by various divisions. See your Cadillac dealer for details.

**Manufacturer's Suggested Retail Price including dealer prep. as of 3/31/81. Tax, license, destination charges and optional equipment additional. Destination charges vary by location and may affect this comperison. *Level of standard equipment varies.*

For years foreign car manufacturers have boasted about their gas mileage, standard features and interiors. But now, there's a car that beats the imports at their own game. Cimarron by Cadillac.

As the chart shows, Cimarron has features the imports have, plus Cadillac comfort and convenience, with reclining body-contoured bucket seats and perforated leather seating areas. Cimarron has front-wheel drive, just as the Cadillac Eldorado and Seville do. It comes with Cadillac's exclusively tuned, road-hugging touring suspension and a four-speed manual transmission including overdrive. What's more, Cimarron behaves like a civilized car should. Nimble . . . easy to maneuver . . . with a smooth, refined ride.

If you've been thinking about buying an import, it's time to re-think your decision. It's time for Cimarron.

Due to limited initial production, Cimarron is not available at all Cadillac dealers at this time.

BY CADILLAC *Cimarron*

A NEW KIND OF CADILLAC FOR A NEW KIND OF CADILLAC OWNER

GM

NATURAL HISTORY

Vol. 90, No. 8, August 1981

American Museum of Natural History
Robert G. Goelet, President
Thomas D. Nicholson, Director

Alan Ternes, Editar
Judith Friedman, Managing Editor
Thomas Page, Designer
Board of Editors: Caral Breslin, Sally Lindsay, Frederick Hartmonn, Vittorio Maestra, Rebecca B. Finnell
Florence G. Edelstein, Copy Chief
Rita Campon, Copy Editor
Kay Zakariasen, Picture Editor
Douglas J. Preston, Publicatians Editar
Susan Rosenberg, Editorial Asst.
Lillian Berger
Editorial Advisers: Molcolm Arth, James W. Atz, Niles Eldredge, Kenneth L. Franklin, E. Craig Morris, Norman Newell, Thomas D. Nicholson, Martin Prinz, Gerard Piel, Nina Root

David D. Ryus, Publisher
Bradford D. Smith, Business Manager
Frederick E. Grassman, Production Mgr.
Debro Buck McCord, Asst. Productian Mgr.
Ernestine Weindarf, Administrative Asst.
Elaine M. Callender, Advtg. Praduction Mgr.
Lauren Krenzel

Daniel J. Dynan, Asst. Circulation Mgr.
Bob Bruno, Fulfillment Mgr.
Romón E. Alvarez, Circulation Asst.

NATURAL HISTORY *(ISSN 0028-0712), incarporating Nature Magozine, is published monthly by the American Museum of Natural History. Central Park West at 79th Street, New Yark, N.Y. 10024. Subscriptions: $15.00 a year. In Canada and all ather countries: $18.00 a year. Second-class postage paid at New York, N.Y. and at additianal affices.*

Copyright © 1981 by American Museum af Natural Histary. All rights reserved. No part of this periodical may be reproduced without written consent of Natural History. *The opinions expressed by authors do not necessarily reflect the policy of the American Museum.* Natural History *is indexed in* Reader's Guide to Periodical Literature.

Advertising Offices:
Natural History Sales
488 Madison Avenue
New York, N.Y. 10022
President of Sales, Arthur Hill Diedrick
Advertising Manager, Katherine José

Telephone Numbers:
Advertising Sales (212) 826-9467
Museum Information (212) 873-4225
Subscription Orders (800) 247-5470
(800) 532-1272 (in Iowa)

Change of address notices, undeliveroble copies, orders far subscriptians, and ather mail items are to be sent to
Natural History Membership Services
Box 4300
Bergenfield, New Jersey 07621

2 Authors

6 The Importance of Mother's Milk *Graham Carpenter*
Cow's milk is ideal . . . for baby cows.

16 This View of Life *Stephen Jay Gould*
What Color Is a Zebra?

24 A Naturalist at Large *Niles Eldredge*
The Elusive Eureka

28 Sky Reporter *Stephen P. Maran*
Debut of an Interstellar Bubble

32 Volcanoes and the Maya *Payson D. Sheets*
Powerful eruptions have repeatedly devastated Central America and entombed a rare archeological record.

42 Sleight of Wing *Tex A. Sordahl*
Crafty avocets and stilts fool many predators and ornithologists.

50 The Whale Behind the Tusk *Randall R. Reeves and Edward Mitchell*
The narwhal's history and biology are isolated by Arctic ice and shrouded in myth. It's future is cloudy, too.

58 Weeds That Ride the Rails *Robert M. Arnold*
Some plants thrive in the harsh railroad environment.

66 I'd Rather Be a Messenger *Jack M. Kugelmass*
When a winter storm paralyzes New York City, lowly bicycle messengers suddenly become heroes.

76 Celestial Events *Thomas D. Nicholson*

78 Books in Review *Richard Edes Harrison*
Representing Earth

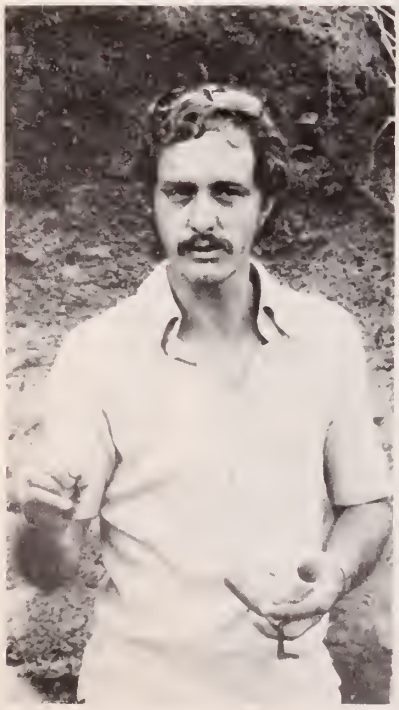
82 Additional Reading

84 At the American Museum
The Nature Faker

88 A Matter of Taste *Raymond Sokolov*
Planter's Lunch

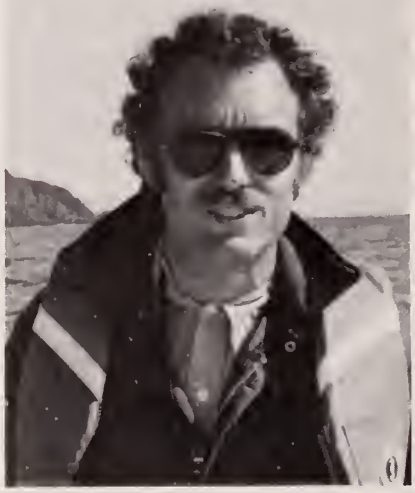
Cover: *The fired-clay figurine was found at a Maya burial site of the Late Classic period (A.D. 600 to 900) on the island of Jaina, off the Yucatán Peninsula. Photograph by Lee Boltin. Story on page 32.*

Aware that volcanoes played a part in Maya prehistory—and with vivid memories of climbing an erupting Guatemalan volcano in 1969—**Payson D. Sheets** surveyed El Salvador for a Maya archeological site that would reveal the effects of volcanism. In 1978 his investigations led him to Cerén, a Pompeii-like site that had been partly exposed by bulldozing but whose potential value had not been appreciated. His initial excavations proved most rewarding, but the current civil war in El Salvador has interrupted the work. In the meantime, Sheets, an associate professor in the Department of Anthropology at the University of Colorado at Boulder, is conducting an experiment based on his archeological research. Having discovered that fractured obsidian edges are much sharper than surgical steel blades, he is collaborating with an eye surgeon to apply the ancient technology for making stone tools to the manufacture of scalpels.



"I became totally enamored of avocets and stilts the first time I saw them in the spring of 1974," reports **Tex A. Sordahl,** an assistant professor of biology at Luther College in Iowa. His interest grew as his familiarity with the birds' behavior increased. "I even endured my friends ribbing me about being a 'legs man.'" Sordahl studied avocets and stilts intensively during 1977, 1978, and part of 1979 at two sites in Utah: a private hunting area known as the Barrens and the Bear River Migratory Bird Refuge. He hopes to observe the behavioral ecology of mountain plovers in Colorado as his next project and to continue his work on the antipredator behavior of shorebirds.





Randall R. Reeves, a research associate with the Canadian government's Arctic Biological Station in Quebec, spent several months observing the Eskimo narwhal hunt. Why narwhals? "They live in remote areas, little is known about their lives, and the value of their tusks creates the potential for serious conservation problems." A graduate of the University of Nebraska in Lincoln and of Princeton University, Reeves is studying the history of exploitation and the current status of the humpback whale in the western North Atlantic. His research on narwhals was supported by the Peoples' Trust for Endangered Species in England.

Coauthor **Edward Mitchell** is a research biologist with the Canadian Department of Fisheries and Oceans and serves on the Scientific Committee of the International Whaling Commission. Concerned with the ecology and population dynamics of North Atlantic whales, Mitchell has also published articles on fossil marine mammals.



Europe's greatest wild bird artist creates his first porcelain bowl



Shown less than actual size of 10" in diameter.

'The Game Bird Bowl' by Basil Ede.
Hand-decorated in 24 karat gold and issued in limited edition.

The art of Basil Ede is known and collected the world over. It has earned him critical acclaim as "the outstanding wild bird portraitist of his generation." And he is one of the few British artists ever honored with a one-man show at America's Smithsonian Institution.

'The Game Bird Bowl' is Ede's first porcelain bowl. A work unlike any other he has ever created. An achievement to be treasured, and kept in your family for generations. And you are invited to acquire this work now.

Crafted in fine white porcelain—the perfect background for the sweeping lines and rich natural hues of Basil Ede's art—the bowl will be a showpiece. Its subject is the beautiful Black Grouse, portrayed in its natural habitat on the Scottish moors. To add the final touch of elegance and refinement, the bowl will be hand-decorated, at the crown and at the base, with bands of pure 24 karat gold. The original issue price is $150.

Each bowl will be produced to individual order by Franklin Porcelain, the only house ever authorized to issue Basil Ede's work in porcelain. Responsibility for its crafting will be entrusted to our associates in Japan, where artistry in porcelain represents a heritage some four centuries old.

In keeping with established tradition for fine works in porcelain, the bowl will be issued for a limited period of time. Advance orders are being accepted until August 31, and the bowl will be withdrawn forever at the end of 1982. A Certificate of Authenticity, together with a commentary on the art of Basil Ede, will accompany the work.

To acquire 'The Game Bird Bowl', please return the attached form by the advance ordering deadline of August 31, 1981.



© 1981 FP

ADVANCE ORDER FORM

THE GAME BIRD BOWL

Valid only if postmarked by August 31, 1981.
Limit: One porcelain bowl per person.

Franklin Porcelain
Franklin Center, Pennsylvania 19091

Please enter my order for 'The Game Bird Bowl', the first porcelain bowl by Basil Ede, to be crafted for me in fine porcelain.

I need send no money now. I understand that I will be billed in three monthly installments of $50.* each, with the first payment due in advance of shipment

**Plus my applicable state sales tax*

Signature _____
ALL ORDERS ARE SUBJECT TO ACCEPTANCE

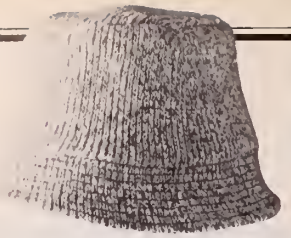
Mr.
Mrs.
Miss _____
PLEASE PRINT CLEARLY

Address _____

City _____

State, Zip _____

Please allow 6 to 8 weeks from deadline for shipment.



RAGG KNIT SLOUCH HAT

Our Ragg Knit version of the classic "bucket-crown" Irish field hat. Knit from 85% wool with natural lanolin for warmth and water repellency, and 15% nylon for strength. Folds for stuffing in pocket or bike pack. One size fits men, women and youths. **Color:** Salt & Pepper twist. **Ragg Knit Slouch Hat $13.95** postpaid.

Order Today! Money Back Guarantee!

Here is my check or money order for $ _____
(Add sales tax where applicable.)
Please RUSH my **#1996 Ragg Knit Slouch Hat.**

Name _____

Address _____

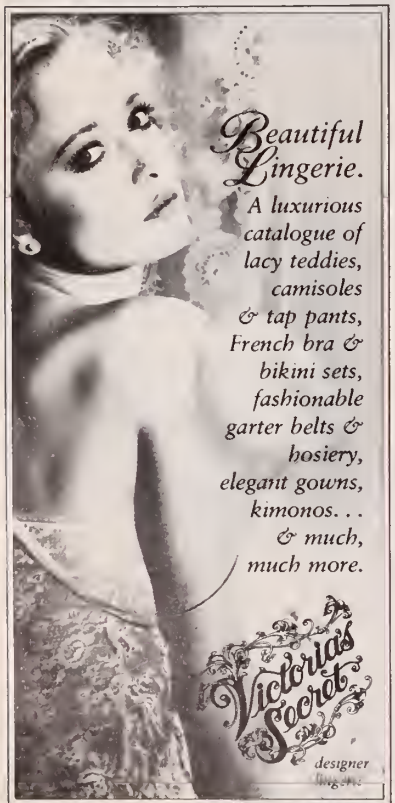
City _____

State _____ Zip _____

Send me your FREE color catalog of quality outdoor apparel and equipment.

Eddie Bauer®

Dept. JNH, Fifth & Union, Seattle, WA 98124



Send $3 for catalogue to NH-08 Box 31442, San Francisco CA 94131
Boutiques in San Francisco, Palo Alto & Cupertino, CA



Born in Scotland, **Robert M. Arnold** received a Ph.D. in physiological plant pathology from Simon Fraser University in British Columbia and has been assistant professor of biology at Colgate University for the past five years. A "childhood interest in trains, professional training in biology, and a delight in being out in the country looking at plants" all came together, he says, in research on the reproductive and dispersive strategies of plants that grow along railroad tracks. Arnold is currently comparing insect pollination in such weeds as dwarf snapdragon, an annual that grows well on railroad cinders, and butter-and-eggs, a perennial that is widespread along roadsides and waste places.

The idea of studying New York City's bicycle messengers was suggested to **Jack Kugelmass** (left) by **Yoav Levy**, whose photographs illustrate the story. In addition to the opportunity to learn about these modern "mavericks," Kugelmass saw the chance to earn some money in his role as a participant-observer. "In fact," he says, "given the limited prospects for anthropologists' careers, I found that the line separating me from the messengers became increasingly blurred." Kugelmass is an associate in anthropology at the Max Weinreich Center for Advanced Jewish Studies at the YIVO Institute in New York City.



The Mayans called their city Uxmal.
You'll call it unforgettable.

A world of wonder. A world of value.

MEXICO

You'd have to crisscross the globe to find all the vacation riches waiting for you in Mexico. In one country, one visit... which we're sure will lead to many more... you'll experience an unforgettable panorama of sights and sensations. The temples of Uxmal beckoning you to the top. The silver shops of Taxco tempting you to stop. Guadalajara's music. Cozumel's crystal seas. Puerto Vallarta's balmy blend of elegance and ease.

And our world of wonder goes on. A fascinating land made even more appealing as Mexico maintains its reputation as one of the great travel values. The extraordinary vacation. At a most ordinary price.

See your ASTA Travel Agent

MEXICO
The Amigo Country

Mexican Government Tourism Office
9701 Wilshire Boulevard–Suite 1201
Beverly Hills, CA 90212

Please send me your newest brochure "Mexico. The Amigo Country"

Name _____

Address _____

City _____

State _____ Zip _____

(Please print)

NH-8/81

MEXICO
THE Amigo COUNTRY

Secretaría de Turismo · Consejo Nacional de Turismo

The Importance of Mother's Milk

Among its other significant ingredients, human milk contains a hormone, known as epidermal growth factor, that stimulates cell division

by Graham Carpenter

Reproduction of the species is considered to be the driving force in the evolution of biological systems, and nature has a large investment in a newborn organism. This is particularly true of humans and other large mammals that have relatively long gestation periods and usually produce only one or two offspring at each birth. Survival of these newborns is critical to the continuance of each species, and for almost all mammals, milk is the material that provides total nourishment during the initial stages of life. The exception is the human species, which in the last several decades has in large numbers shifted from milk to substitutes.

At the turn of the century approximately 50 percent of all newborn babies in the United States were breast-fed for at least the first twelve months of life. Recent surveys indicate that during the 1970s about one in three babies was nursed during the first month of life. Concurrently, the duration of breast-feeding declined rapidly, to the point that about 5 percent of all infants were nursed until six months of age and 1 percent until twelve months of age. At present there is a shift among new mothers to return to breast-feeding, but this group is small in relation to the total population. In today's era, when information is prized and decision making based on biological instinct is, perhaps unfortunately, frowned upon, it would seem that data about such an important commodity as milk (and its commercial formula substitutes) should be of concern to both the public and the medical profession.

Too frequently the assumption is made that "milk is milk," and whether a newborn human drinks mother's milk or cow's milk is of no large consequence. A second assumption is that today's technology is so advanced that artificial formulas can duplicate the quality of natural human milk. Both of these assumptions are incorrect. Comparison of the composition of milk from various species shows that there exist significant qualitative and quantitative differences, which seem to reflect the varying needs of each species for proper development in early life. For example, compared to human milk, the milk of the bovine species has twice as much protein, which after digestion provides the newborn with a source of raw materials, that is, amino acids, for muscle growth. This increased protein content reflects the needs of almost all newborn animals (excluding humans) to grow rapidly in order to avoid predators, become independent quickly, and survive. A newborn cow, for instance, will double its birth weight in about 50 days, whereas a newborn human requires 180 days. Because human milk is relatively low in protein does not mean that it is insufficient in that respect. Human infants do not need to add bulk as rapidly as other newborn animals, but have different needs, including maintaining a higher rate of brain growth.

Myelination—the surrounding of nerve axons with a lipoprotein membrane, or sheath, necessary for the proper conduction of nerve impulses—is an important process of human brain growth in the first year of life. Myelination requires substantial quantities of lipid, and human milk has a relatively high lipid content. Lipid intake is also important for the baby of lower weight who, to maintain a proper body temperature, must produce fat for insulation.

Comparative analyses of milk compositions provide many examples such as these and quite strongly demonstrate that each species has during its evolution devised a milk composition that is optimal for its specific needs. The high degree of sophistication of the biological mechanisms that control the composition of milk is demonstrated by the capacity of mothers of preterm babies to produce a milk with a higher content of protein and lipid than is found in the milk of mothers of full-term babies. Nature apparently provides the preterm, low-weight infant with extra protein to increase its body mass, or weight, and with extra lipid to stabilize body temperature and to provide more fuel for energy production.

Most of our present knowledge of milk composition concerns those components that are present in milk in the largest amounts—macronutrients such as protein, carbohydrate, and lipid. There is also a reasonable body of data describing the levels and different types of minerals and vitamins. Milk, however, is more complex than is currently understood, and there are increasing feelings in the scientific community that, in addition to satisfying nutritional needs, milk may provide other, subtle but important factors for growth and development in the newborn. For example, the antibodies passed through milk from mother to child help the newborn, whose ability to produce antibodies has not fully developed, resist microbial infections. Breast-fed babies do, in fact, suffer fewer infections, par-



Your Bank _____ Account Number _____

City & State _____

PAY TO THE ORDER OF Save the Children 19 $16.00

Sixteen and no/100 ~~~~~ DOLLARS

(Signature) _____

MEMO: *U.S. Income Tax Deductible Monthly Sponsorship*

(Your Address) _____

City & State _____ Zip _____

Fill out this check (or use your own) and save the children

For only 52¢ a day (just $16 a month) you can befriend a needy child through Save the Children. Your money, combined with that of other sponsors, can breathe new life into an impoverished village...help hardworking people in their fight for dignity...turn despair into hope for a child who has known only disaster. 52¢ may not buy much where you live. But for the poorest of the poor, where the need is so desperate, it can work miracles.

For your first monthly sponsorship contribution, just fill out and sign the check at the top of this page (yes, as long as you indicate your bank name and account number, it is negotiable). Mail the entire page to Save the Children. Of course, you may use your personal check if you prefer.

TELL US HOW YOU WANT TO HELP BY ANSWERING THESE QUESTIONS.

Your name _____ (please print)

Address _____

City _____ State _____ Zip _____

1 What kind of child would you like to help?
☐ Boy ☐ Girl ☐ Either

2 What geographical area are you interested in?
Urgent need exists in all the areas listed below. Select an area, or let us assign a child where the need is greatest.

☐ **Where the need is greatest**
☐ Africa
☐ American Indian
☐ Bangladesh
☐ Chicano (U.S.)
☐ Colombia
☐ Dominican Republic
☐ Honduras
☐ Indonesia
☐ Inner Cities (U.S.)
☐ Israel
☐ Lebanon
☐ Mediterranean
☐ Mexico
☐ Nepal
☐ Southern States (U.S.)
☐ Sri Lanka (Ceylon)

3 Would you like a picture of your sponsored child?
Shortly after we select a child for you, we can send you a photograph and brief personal history, if you desire.
☐ Yes ☐ No

4 Would you like to correspond with your sponsored child?
If desired, correspondence can help build a meaningful one-to-one relationship. Translations, where necessary, are supplied by Save the Children.
☐ Yes ☐ No

5 Would you like information about the child's community?
When you become a sponsor, your funds are used to help children in the most effective way possible—by helping the entire community with projects and services. For health care, education, food production, and nutrition. Several times a year you can receive detailed reports on these community activities which provide permanent improvements to the child's environment. Would you like to receive such information?
☐ Yes ☐ No

6 Do you wish verification of Save the Children credentials?
Save the Children is indeed proud of the handling of its funds. Based on last year's audit, an exceptionally large percentage (83.5%) of each dollar spent was used for program services and direct aid to children and their communities. Due to volunteered labor and materials, your donation provides your sponsored child with benefits worth many times your total gift. Would you like to receive an informative Annual Report (including a summary financial statement)?
☐ Yes ☐ No
(A complete audit statement is available upon request.)

7 Would you rather make a contribution than become a sponsor at this time?
☐ Yes, enclosed is my contribution of $_____.
☐ Check here for general information about our unique programs for aiding impoverished children.

© 1981 SAVE THE CHILDREN FEDERATION, INC

NH 8 1 1A

Mail to:

Save the Children®
50 Wilton Road, Westport, Connecticut 06880
Attn: David L. Guyer, President

YOUR SPONSORSHIP PAYMENTS AND CONTRIBUTIONS ARE U.S. INCOME TAX DEDUCTIBLE.

Established 1932. The original U.S. child sponsorship agency. Member of American and International Councils of Voluntary Agencies

The Franklin Mint Record Society,
in collaboration with Count Basie, Les Brown, Lionel Hampton, Woody Herman,
Harry James, Sammy Kaye and a panel of distinguished music authorities,
is proud to present . . .

THE GREATEST RECORDINGS OF THE BIG BAND ERA

ARCHIVE COLLECTION

The most comprehensive collection of
original big band recordings ever assembled.
And the first ever issued on superior proof-quality records.

© 1981 FMRS



SUBSCRIPTION APPLICATION

THE GREATEST RECORDINGS OF THE BIG BAND ERA

ARCHIVE COLLECTION

The Franklin Mint Record Society
Franklin Center, Pennsylvania 19091

Please mail by August 31, 1981.

Please enter my subscription for *The Greatest Recordings of the Big Band Era* consisting of 100 proof-quality records in special hardbound albums. I understand that I may cancel my subscription at any time upon thirty days' notice. No payment is required at this time. I will be billed for each record in advance of shipment, at $9.75* plus $1.75 for packaging, shipping and handling. My records will be sent to me at the rate of two per month.

**Plus my state sales tax*

☐ Check here to receive the collection on standard Dolby** encoded tape cassettes. Same price as above, shipped two per month.

***Trademark of Dolby Laboratories*

Signature _____
ALL APPLICATIONS ARE SUBJECT TO ACCEPTANCE

Mr.
Mrs.
Miss _____
PLEASE PRINT CLEARLY

Address _____

City _____

State _____ Zip _____

GUARANTEED PRICE: In spite of strong inflationary pressures in the record industry, the price of $9.75 per record or cassette will be *guaranteed* to you by The Franklin Mint Record Society for the entire series.

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

UD

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO 1 FRANKLIN CENTER PENNSYLVANIA

POSTAGE WILL BE PAID BY ADDRESSEE

The Franklin Mint Record Society
Franklin Center, Pennsylvania 19063

B

"We wanted this collection to have it all! The great bands, the soloists and the singers. It's good to know this music is all here . . . all together . . . for now and the future."

—Count Basie

The greatest authorities on the music of America's big band era—musicians and music critics alike—have joined together, for the first time, to assemble *the definitive collection of big band recordings.*

This is a collection unlike any issued before. For the bandleaders, writers and critics who comprise this panel are the very same ones who shaped the big band era.

These experts enlisted the cooperation of the record companies which now hold the *original master recordings* of the big name bands. Thus, the panel was able to make its selections from virtually every big band performance ever recorded—*making this the first such collection ever assembled from all the big band record labels.*

As a result, this will be the most complete, comprehensive and authoritative collection ever devoted to big band music. And it will be the first ever available on *proof-quality* records of exceptional fidelity.

All the great bands, singers and soloists in their greatest recorded performances

The Archive Collection of *The Greatest Recordings of the Big Band Era* will be all-encompassing. A collection which reflects the musical diversity of the era. The crisp swing of Benny Goodman and Artie Shaw, the relaxed rhythm of Count Basie and Jimmie Lunceford, the bright dixieland of Bob Crosby, the sophisticated stylings of Duke Ellington, the dreamy delicate sounds of Ray Noble, the soft, sweet music of Guy Lombardo and Sammy Kaye. It will also include:

The musical forerunners of the era—Paul Whiteman, with Bing Crosby and Bix Beiderbecke; Fletcher Henderson, who influenced Benny Goodman and many others; the early sounds of Glen Gray and Fred Waring.



The nostalgic themes of the big bands—Glenn Miller's "Moonlight Serenade" . . . Tommy Dorsey's "I'm Getting Sentimental Over You" . . . Louis Armstrong's "When It's Sleepy Time Down South" . . . Vaughn Monroe's "Racing with the Moon."

The greatest hits of an entire generation—Charlie Barnet's "Cherokee," Duke Ellington's "Take the 'A' Train," Artie Shaw's "Frenesi," Frankie Carle's "Sunrise Serenade," Tommy Dorsey's "Opus One," Eddy Duchin's "Stormy Weather," and Benny Goodman's "Sing, Sing, Sing," with Gene Krupa.

The big band vocalists that audiences loved . . . and still remember. Frank Sinatra with Tommy Dorsey, Peggy Lee with Benny Goodman, Doris Day with Les Brown, Anita O'Day with Gene Krupa, Bob Eberly and Helen O'Connell with Jimmy Dorsey. And many more, including Perry Como, Lena Horne and Ella Fitzgerald.

The ultimate collection of original big band recordings

This is a collection that would be difficult—or impossible—for any individual to assemble. For these selections have been drawn from the archives of all the major record companies . . . and such vintage labels as Brunswick, OKeh, Vocalion, Bluebird and Perfect.

Many of these recordings—like Wayne King's "Melody of Love"—have been *unavailable for years.* Others are *hard to find recordings* of early radio broadcasts . . . such as Frank Sinatra's emotional farewell to the Tommy Dorsey Orchestra, doing his spectacular rendition of "The Song Is You." Still others were only released on 78s—and *never re-issued:* Eddy Duchin's "Ol' Man Mose," and Bob Crosby's "Black Zephyr."

In many cases, the panel considered several *different* versions of the *same* song, before selecting a particular recording for the collection. Thus, *every* selection will be a classic performance. An original recording of the era . . . recaptured on records of superior listening quality.

Superb quality for today's audio systems

These records will be produced to the highest standards possible by The Franklin Mint Record Society—judged by audio experts to produce some of the finest records available today.

Each recording will first undergo a painstaking restoration process—electronically "cleaned" groove-by-groove to eliminate extraneous surface noise and preserve the original brilliance of the music.

The records will be pressed in a dust-free "clean room" using a special vinyl that contains its own anti-static element. This meticulous pressing technique, together with the special record vinyl, results in a more rigid, durable and dust-resistant record. A *proof quality* record that actually *sounds better* than the original—and may be played through any audio system.

Hardbound albums and big band histories provided

In keeping with the importance of this collection, special hardbound albums have been designed to house and protect all one hundred proof-quality records.

Each album holds two long-playing records, together with an expertly written commentary—prepared by members of the advisory panel, and illustrated with photographs of the bands. A complete reference index to bandleaders, songs and solo artists will also be provided.

Available by subscription only

If you remember the big bands . . . if you've ever wished to relive the music of that period . . . or if you've only just discovered this unique sound in American popular music . . . *this* is your opportunity. An opportunity to share and enjoy—with all the members of your family—the unforgettable sound of the big bands.

The collection may be acquired only by direct subscription. It will not be sold in record stores. To subscribe now, mail the attached application to The Franklin Mint Record Society, Franklin Center, Pennsylvania 19091. Please do so by August 31, 1981.







Strict record pressing standards, and audio and visual inspection, assure high quality. Ordinary records (left) have static charges that attract dust, causing surface noise. But the special anti-static vinyl used in Franklin Mint records (right) assures clearer sound. Electrostatic meter tests show that the Franklin Mint record has only one-fifth the static charge of ordinary records.

The Advisory Panel

COUNT BASIE for more than 40 years, leader of one of the most consistently swinging bands in history.

LES BROWN outstanding writer, arranger and leader of one of the era's most popular dance bands.

DAVE DEXTER, JR. a record producer for 31 years, former *Down Beat* editor and author of *The Jazz Story* and *Playback.*

LIONEL HAMPTON a leader whose exuberance has inspired musicians and audiences alike for more than five decades.

WOODY HERMAN who continues to be one of the most popular and successful of all leaders—discoverer of many talented musicians.

HARRY JAMES a brilliant trumpeter of both beautiful ballads and rip-roaring swing.

SAMMY KAYE "Mister Swing and Sway," master of the sweet sound—always popular, always danceable.

NEIL McCAFFREY music critic and editor of *American Dance Band Discography* and *The Complete Encyclopedia of Popular Music and Jazz.*

GEORGE T. SIMON music critic, record producer, author of the definitive work on dance bands—*The Big Bands*—and *The Best of the Music Makers.*

RICHARD SUDHALTER jazz critic of The New York Post, author of *Bix: Man and Legend,* and a widely respected jazz cornetist.

JOHN S. WILSON jazz and popular music critic of The New York Times, author of *Jazz: The Transition Years, The Collector's Jazz: Traditional and Swing, The Collector's Jazz: Modern.*

ticularly of the gastrointestinal tract, than formula-fed babies.

Hormones, the body's chemical messengers, are other kinds of molecules present in milk. Most hormones are either proteins (insulin, for example) composed of many amino acids or have chemical structures related to steroids. A characteristic of all hormones is that they are present in body fluids in exceedingly small quantities compared with other components. Nevertheless, hormones play a vital role in regulating body chemistry and physiology. For instance, an individual can ingest large amounts of carbohydrates but unless insulin is present the carbohydrates will not be utilized properly. Similarly, other hormones control virtually all processes that the body carries out. There are a number of hormones known to be present in human milk, but their significance has not been demonstrated. This does not mean these molecules have no significance; it simply means that none is yet understood.

Also present in milk is an interesting class of hormones—often referred to as growth factors—that controls cell growth and differentiation. Research in this area is relatively new and it is very likely that many more growth factors will be identified in the future. Of those now known, one of the most thoroughly investigated is epidermal growth factor, or EGF. Epidermal growth factor is a small protein molecule composed of fifty-three amino acid residues. Discovered in the early 1960s in mice by Stanley Cohen, a biochemist at Vanderbilt University, this hormone has since been detected in many mammalian species. It is present in almost all human body fluids, including milk, where its concentration (approximately thirty nanograms per milliliter) is quite significant for a hormone.

The classic procedure for determining the function of a hormone has been to surgically remove the hormone-producing organ and record the resultant effects of the hormone deficit. The observed effects can be attributed to the hormone deficit if the effects are prevented or reversed by injection of the hormone into the animal. This experimental strategy is not always possible, however. In the case of EGF, it is not known where in the body the hormone is produced, and the available evidence suggests that there are probably several distinct sites. Therefore, it has not been possible to determine unequivocally what functions EGF serves. There are experiments, however, that demonstrate quite interesting biological effects when EGF is administered to animals. These results probably provide good clues to the natural function of this hormone.

Cohen's pioneering studies demonstrated that EGF had a pronounced stimulatory effect on the growth and differentiation of the outermost layer of the body, the epidermis of the skin—hence the name epidermal growth factor. In those initial experiments, newborn mice were injected daily with small quantities of EGF, and an intriguing result was observed. Normally, a newborn mouse is born with its eyelids shut and, without exception, its eyelids open at thirteen to fourteen days after birth. But baby mice injected with the epidermal growth factor opened their eyelids in seven days. The proliferation of skin cells in the eyelid area and their differentiation, a process called keratinization, had been accelerated. Later studies have demonstrated that the effect was not limited to the eyelid area; all areas of the epidermis were similarly stimulated to proliferate and keratinize in newborn animals treated with EGF.

More recent experiments have shown that EGF stimulates epithelial tissues other than the skin. The entire gastrointestinal tract is lined with epithelial tissue, and several studies have shown that EGF stimulates cell division and accelerates certain differentiation events in this tissue. During development in the perinatal period, the cells of the gastrointestinal tract begin to produce hydrolytic enzymes—protein molecules required for the digestion of food. The rates of activity of these enzymes are generally low at birth and increase as the infant matures. If these digestive enzymes do not develop at the correct time, the infant is less able to utilize food to sustain its nutritional requirements, and obviously, a long delay in the maturation of the digestive enzymes has serious consequences. A recent study by a Canadian group at the University of Sherbrooke in Quebec reports that when newborn mice are injected with EGF the maturation of several digestive enzymes is accelerated. Thus the hormone may have a significant function in the growth and development of this important system.

A second critical transition for the newborn infant occurs at birth, when maternal oxygen, which was delivered *in utero,* is no longer available; suddenly oxygen must be taken in from the air and, via the lungs and circulatory system, made available to the tissues. Failure to adjust successfully to atmospheric oxygen at birth creates a respiratory distress syndrome called hyaline membrane disease. This is, of course, a serious condition, and one that is seen not infrequently in the baby born prematurely. The premature infant is especially vulnerable to this problem because the final stages of lung maturation in the fetus normally occur just prior to full-term birth. Hyaline membrane disease cannot be predicted before birth, and the mortality rate is low but significant.

This respiratory syndrome has been studied in newborn lambs, and the results show that in cases where pregnant ewes are subjected to stress and their lambs delivered prematurely, many of the lambs (75 percent) die soon after birth of respiratory distress similar to the hyaline membrane disease seen in human infants. When the fetal lambs are infused *in utero* with EGF for a few days prior to premature delivery, however, development of the lung epitheliums is accelerated, respiratory distress is infrequent, and almost all of the lambs survive. Moreover, in these same experiments, accelerated growth of epi-

WHEN YOU WRITE TO NATURAL HISTORY

about a change of address, renewal of subscription, billing, or any kind of adjustment, send the present address label from the magazine wrapper.

Moving? Please notify 6 weeks in advance. You can use this form to tell us about a move or order a subscription.

Change of address—Attach your address label in the dotted area and fill in your new address below, clip and mail to Natural History Membership Services, P.O. Box 4300, Bergenfield, N.J. 07621.

Cut your old address label from magazine wrapper and attach over this area.
Fill in your NEW address and mail to:
Natural History Magazine
Membership Services P.O. Box 4300
Bergenfield, N.J. 07621

PLEASE PRINT

Name _____

New Address _____

City _____ State _____ Zip _____

Turn Your Bookshelf Into a Complete 21-Volume Science Library for Only $39.95.

"Men and Numbers" —Muir
"Celestial Bodies" —Copernicus
"Theory of Relativity" —Einstein
"Human Understanding" —Locke
"Communications in the Space Age" —Kappel
"Creative Evolution" —Bergson
"Origin of Species" —Darwin
"Burning-sphere" —Alhazen



"Irrational Numbers"—Dedekind
"Cybernetics" —Wiener
"Behind the Flying Saucers" —Scully
"Four Basic Elements" —Aristotle
"Computer and the Brain" —Neumann
"Division of Figures" —Euclid

Pub. at ~~$149.95~~
B&N Price
$39.95

A Science Education from A to Z

From the *ABC of Relativity* by Bertrand Russell, to Zeno's paradoxes, this 21-volume library provides a complete and fascinating science education.

Unlike an encyclopedia, this reference work is one you can read for pure enjoyment as well as refer to for reliable information. The key to this readability is the fact that THE REALM OF SCIENCE is actually a massive collection of selected writings arranged and indexed by subject. It is so complete, that the cumulative index alone runs almost 200 pages!

Think of a subject, look it up, and read what the world's foremost authorities have written about it.

The Greatest Minds the World Has to Offer

The authorities represented in this priceless collection read like a "Who's Who" in science. There's Priestley on the discovery of oxygen; Faraday on electrochemistry; E.O. Wilson on sociobiology; Ernst Nagel on Godel's proof. Plus Isaac Asimov, Jacob Bronowski, Martin Gardner, Max Planck, James Watson, George Gamow, Fritz Zwicky, and hundreds more. From ancient Babylonia to the present, you will be exposed to the greatest minds the world has to offer.



Einstein's special theory of relativity changed our concept of time, distance and mass.

A Valuable Research Tool

Although each volume contains its own index, the unique Science Concept Index "brings it all together." It will help you find vital information on a given subject, person, place or idea throughout the set. It will also enable you to trace various applications of a subject from one author to another, from one concept to another, or from one discipline to another. Imagine what a valuable research tool this can be. Taken as a whole, this 21-volume set provides an overview of science never before possible in a single work.

SOME OF THE CONCEPTS COVERED

—Air
—Astronomy
—Atoms
—Axioms-Laws-Principles
—Bshavior
—Biology
—Cells
—Chemistry
—Communication
—Computsrs
—Conssrvstion
—Continuity
—Cosmology
—Dessrt
—Earth
—Ecology
—Electricity snd Magnetism
—Elements
—Embryology
—Energy
—Entropy
—Equilibrium
—Evolution
—Force
—Genetics and Heredity
—Geology
—Gravity
—Hest
—Heredity
—Instruments and Apparstus
—Infinity
—Insight
—Knowledge
—Light snd Optics
—Logic
—Msn
—Mathemstics
—Mattsr
—Measurement
—Mechanics
—Mstabolism
—Molecules
—Motion and Momentum
—Nebulae
—Nuclear
—Oceans, Sess snd Wster
—Parsdoxes
—Parity
—Photosynthesis
—Physics
—Pisnets
—Pollution
—Populstion
—Radistion
—Rslativity
—Reproduction
—Space
—Structure and Form
—Systems
—Technology
—Temperature
—Time

Keep Your Set Up-To-Date

To keep you informed of the latest scientific developments and to keep your 21-volume set up-to-date, you will also be entitled to receive—at your option—the fully illustrated REALM OF SCIENCE yearbook.

At an appropriate time, you will receive advance notification fully describing the upcoming yearbook and will have the option of refusing it if you wish. Barnes & Noble will guarantee the price of $9.95 (plus shipping and applicable taxes) for the first three years. However, you are under no obligation to ever buy a yearbook.

Act Now. . . Our Supply is Limited

THE REALM OF SCIENCE originally sold for $149.95. Until the supply lasts (We purchased the remaining inventory from the publisher), Barnes & Noble is offering the complete 21-volume set for only $39.95. That's about one-fourth of its original price. . . a discount of 73 percent!

Act now, and you won't be disappointed. (Each big 8" *x 10"* hardcovered volume contains almost 200 pages and is fully illustrated.) If you are not completely satisfied with the set, return it within 30 days and the purchase price will be refunded.

BARNES/SALE & NOBLE/ANNEX

NOW SAVE $110

MAIL TO: 0361F
BARNES & NOBLE SALE ANNEX,
DEPT R 526
126 FIFTH AVE., N.Y., N.Y. 10011

Please send me _____set(s) of *The Realm of Science* at only $39.95 each, plus $3.00 postage and insurance charge (N.Y. and N.J. residents: Please add sales tax). If I am not completely satisfied, I may return it within 30 days for a full and prompt refund or credit to my charge account.

I am also entitled to purchase, at my option, the REALM OF SCIENCE yearbook as described in this advertisement.

☐ A check or money order is enclosed.
☐ Please charge this purchase to:

☐ VISA ☐ Discover Card ☐ MasterCard 4 digits above your name

Account # _____

Exp. date _____

Signature _____

Please print clearly

Name _____
Address _____
City _____
State _____ Zip _____

Order subject to acceptance by Barnes & Noble Bookstores, Inc

For Faster Service

CREDIT CARD CUSTOMERS CALL TOLL FREE
1-800-228-2057/Ext. 15
Lines are open 24 HOURS
7 DAYS A WEEK
In Nebraska call 402-571-4900

1981 Barnes & Noble Bookstores, Inc

thelial tissue is noted not only in the lungs but also in other areas of the pulmonary epithelium, such as the trachea and esophagus.

An epithelial tissue in adults that appears to be very sensitive to EGF is the corneal epithelium in the eye. This tissue is important for sight and can be easily injured. Research has shown that in both experimental animals and in humans, EGF accelerates the proliferation of cells in a wounded area of the corneal epithelium, thereby hastening the wound-healing process. Because EGF is present in milk, a natural fluid, clinical trials are being conducted to determine whether milk might be a feasible treatment for corneal lesions. In fact, the use of EGF as a general wound-healing agent is being considered. In this regard, it is interesting to note that folk medicine often prescribes the application of urine to wounds. And in war situations this practice has been employed when other treatments were not immediately available. Urine is usually a sterile solution and contains high amounts of EGF.

Nature is often remarkably ingenious in devising strategies to maximize the utility of its products. In the case of protein molecules, it is not unusual for one protein to be capable of carrying out more than one distinct function. At the level of molecular architecture this is not a trivial engineering task. In addition to its capacity to stimulate cell growth and differentiation, the EGF molecule has a second biological activity. When administered to experimental animals and to humans, this hormone blocks the release of excess gastric acid induced by a variety of chemicals, such as histamine or pentagastrin.

The ability of EGF to control acid secretion in the stomach was discovered unexpectedly in 1975 when a British research group at Imperial Chemical Industries isolated and determined the structure of urogastrone—a protein hormone known since the 1920s to be present in high quantities in the urine of pregnant women and to be an inhibitor of acid secretion. Computer comparisons of urogastrone with other known proteins revealed that the primary structures (that is, the sequences of amino acids) of urogastrone and EGF are so nearly identical (within the limits of experimental technology) that one can conclude they are the same molecule. Thus milk-fed infants receive a hormone that may help to prevent discomforts and injuries to the stomach lining (ulcers, for example) resulting from excess gastric acid.

Scientists have been increasingly successful at removing selected cells from the intact animal and maintaining these cells in a growing state for long periods of time in the laboratory. This technique, called cell culture, involves placing the cells in a plastic dish with a defined medium of glucose, minerals, vitamins, and amino acids. Under these conditions the cells remain viable but do not grow. For growth and cell division to occur, serum—a blood fraction—is added to the medium. Serum apparently contains hormones, or growth factors, necessary to regulate cell growth and division and for many years has been considered to be indispensable for this purpose. Recent experiments, however, have shown that milk is also able to stimulate cell proliferation in cell culture and can make up for approximately 95 percent of the serum requirement. Biologically, this suggests that milk is a fluid rich in the factors that control cell growth, and EGF appears to be a key ingredient in milk for the stimulation of cell division. This has been demonstrated by treating milk with antibodies to EGF.

Antibodies are highly specific reagents that are able to recognize one particular protein molecule in a mixture of thousands of slightly different protein molecules. Antibodies bind to the protein they recognize and often inactivate it. When milk is treated with antibodies to EGF, the capacity of the milk to stimulate cell growth is reduced by 90 percent. This has been demonstrated in cell culture with human fibroblasts (connective tissue cells) and human glia cells (brain-derived cells). Different types of cells are known to vary in their responsiveness to any particular hormone; therefore, it is possible that milk may contain additional growth factors other than EGF that stimulate different cell types. For example, erythropoietin, a protein growth factor that controls the development of red cells in the blood, is known to be present in milk.

In summary, we know that EGF is able to exert a significant influence on the proliferation and differentiation of various types of epithelial cells in the intact animal. We also know that this hormone is present in physiologically significant quantities in milk. Is there a connection? Is milk a physiological vector for the delivery of important hormones to the infant? These intriguing questions will have to wait for further research before answers can be provided. To resolve some obvious questions, however, a few additional comments can be made at this time. If the hormone is ingested in milk and affects the growth and development of tissue in the gastrointestinal tract, it must be able to resist conditions in the gastrointestinal tract that cause the digestion of most protein molecules. Studies of the chemistry of EGF have shown that the hormone's activity is not destroyed by exposure to strong acid or proteases (enzymes that digest protein molecules). Therefore, it is not unreasonable to suggest that this growth factor may remain biologically active in the normally adverse conditions, for a protein molecule, of the gastrointestinal tract.

If EGF also affects other epithelial tissues, such as that of the lungs, then there is a second problem: the growth factor would have to be absorbed into the circulatory system by passing through the lining of the gastrointestinal tract. That this apparently can occur has been demonstrated in the experiments conducted with newborn mice. The results showed that oral administration, as well as subcutaneous injection, of EGF resulted in precocious eyelid opening, indicating that the hormone was absorbed from the gastrointestinal tract into the systemic circulation. This has not, however, been demonstrated with humans, and animal species differ in terms of which proteins will be absorbed.

As already mentioned, large numbers of babies in the United States are not fed with mother's milk but receive commercial formulas with either a soybean or bovine milk base. Does this make a difference as far as growth factors are concerned? Cells grown in culture can be stimulated to grow and divide by either human or bovine milk. When various commercial formulas were tested, however, none were able to stimulate cell proliferation. This is not to be taken as an indictment of the commercial formulas—certainly many children have been raised on formula without apparent adverse consequences. These results indicate that human milk is not duplicated by the industrial products and that our scientific technology is not always able to better or even equal nature.

Graham Carpenter is an assistant professor of biochemistry and medicine in the Department of Biochemistry of Vanderbilt University's School of Medicine in Nashville, Tennessee.



Welcomed from the Grand Canyon to the Grand Canal.

Wherever you're going, it's good to know your BankAmerica Travelers Cheques are welcome in over 150 countries around the world. That's why we call them World Money.® And if your



cheques are lost or stolen, it's also good to know you can get refund service at more than 40,000 locations both here and abroad.

BA CHEQUE CORPORATION
A BANKAMERICA COMPANY

BankAmerica Travelers Cheques

They make you feel good all over.

What Color Is a Zebra?

Is it a white animal with black stripes? Or vice versa?

by Stephen Jay Gould

Some persistent, unanswered questions about nature possess a kind of majestic intractability. Does the universe have a beginning? How far does it extend? Others refuse to go away because they excite a pedestrian curiosity but seem calculated, in their very formulation, to arouse argument rather than inspire resolution. As a prototype for the second category, I nominate: Is a zebra a white animal with black stripes or a black animal with white stripes? I once learned that the zebra's white underbelly had decided the question in favor of black stripes on a blanched torso. But, to illustrate once again that "facts" cannot be divorced from cultural contexts, I discovered recently that most African peoples regard zebras as black animals with white stripes.

In a poem about monkeys, Marianne Moore discussed some compatriots at the zoo and contrasted elephants and their "strictly practical appendages" with zebras "supreme in their abnormality." Yet we learned last month that the three species of zebras may not form a group of closest relatives—and that stripes either evolved more than once or represent an ancestral pattern in the progenitors of true horses and zebras. If stripes are not the markers of a few related oddballs but a basic pattern within a large group of animals, then the problems of their construction and meaning acquire more general interest. J. B.L. Bard, an embryologist from Edinburgh, has recently analyzed zebra stripes in the broad context of models for color in all mammals. He detected a developmental unity underlying the different patterns of adult striping among our three species of zebras and, *inter alia,* even proposed an answer to the great black-and-white issue in favor of the African viewpoint.

Biologists follow a number of intellectual styles. Some delight in diversity for its own sake and spend a lifetime describing intricate variations on common themes. Others strive to discover an underlying unity behind the differences that sort these few common themes into more than a million species. Among searchers for unity, the Scottish biologist and classical scholar D'Arcy Wentworth Thompson (1860–1948) occupies a special place. D'Arcy Thompson spent his life outside the mainstream, pursuing his own brand of Platonism and packing insights into his thousand-page classic *On Growth and Form*—a book so broad in appeal that it won him an honorary degree at Oxford and, thirty years later, entered the *Whole Earth Catalog* as "a paradigm classic."

D'Arcy Thompson struggled to reduce diverse expressions to common generating patterns. He believed that the common patterns themselves had a kind of Platonic immutability as ideal designs, and that organisms played with constrained variations upon them. He developed a theory of "transformed coordinates" to depict variations as expressions of a single pattern, stretched and distorted in various ways. But he worked before computing machines could express such transformations in numerical terms, and his theory achieved little impact because it never progressed much beyond the production of pretty pictures.

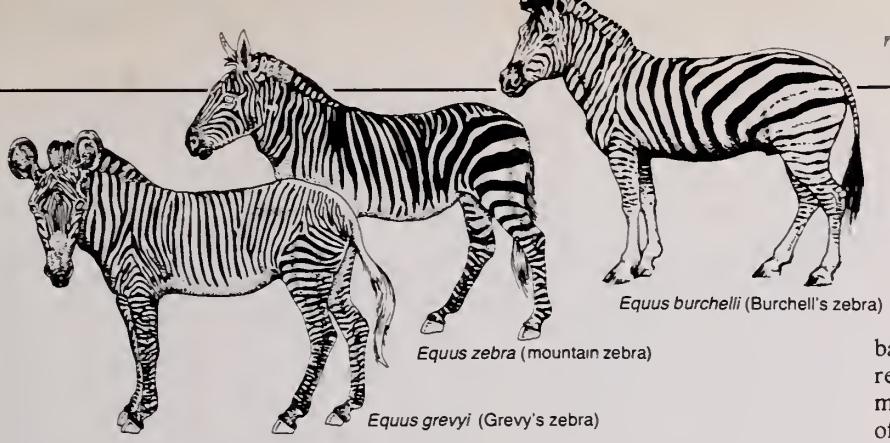
As a subtle thinker, D'Arcy Thompson understood that emphases on diversity and unity do not represent different theories of biology, but different aesthetic styles that profoundly influence the practice of science. No student of diversity denies that common generating patterns exist, and no searcher for unity fails to appreciate the uniqueness of particular expressions. But allegiance to one or the other style dictates, often subtly, how biologists view organisms and what they choose to study. We must reverse the maxim of the reprobate father teaching his son morality—do what I say, not what I do—and recognize that biological allegiances lie not so much in words but in actions and subjects chosen for research. Note what I do, not what I say. Of the "pure taxonomist"—the describer of diversity—D'Arcy Thompson wrote:

> When comparing one organism with another, he describes the differences between them point by point and "character" by "character." If he is from time to time constrained to admit the existence of "correlation" between characters . . . he recognizes this fact of correlation somewhat vaguely, as a phenomenon due to causes which, except in rare instances, he can hardly hope to trace; and he falls readily into the habit of thinking and talking of evolution as though it had proceeded on the lines of his own description, point by point and character by character.

D'Arcy Thompson recognized, with sadness, that the theme of underlying unity had received much lip service, but little application. Differences between the striping patterns of our three zebra species had been described minutely and much energy had been invested in speculations about the adaptive significance of differences. But few had asked whether all the patterns might be reduced to a single system of generating forces. And few seemed to sense what significance such a proof of unity might possess for the science of organic form.

The vulgar version of Darwinism (not Darwin's) holds that natural selection is so powerful and pervasive in scrutinizing every variation and constructing optimal designs that organisms become collections of perfect parts, each minutely crafted for its special role. While not denying correlation in development or underlying unity in design, the vulgar Darwinian does relegate these concepts to unimportance because natural selection can always break a correlation or remold an inherited design.

The pure vulgar Darwinian may be a fiction; no one could be quite so foolish. But evolutionary biologists have often slipped into the practice of vulgar Darwinism (while denying its precepts) by following the reductionistic research strategy of analyzing organisms part by part and invoking natural selection as a preferred explanation for all forms and functions—the point of D'Arcy Thompson's profound statement cited above. Only in this way can I make sense of the curious fact that unity of design has received so little attention in the practice of research—although



AMNH

much lip service in textbooks—during the past forty years, while evolutionary biologists have generally preferred a rather strict construction of Darwinism in their explanations of nature.

For many reasons, ranging from the probable neutrality of much genetic variation to the nonadaptive nature of many evolutionary trends, this strict construction is breaking down, and themes of unity are receiving renewed attention. Old ideas are being rediscovered; D'Arcy Thompson, although never out of print, is now often out of bookstores (and in personal libraries). One old and promising theme emphasizes the correlated effects of changes in the timing of events in embryonic development. A small change in timing, perhaps the result of a minor genetic modification, may have profound effects on a suite of adult characters if the change occurs early in embryology and its effects accumulate thereafter.

The theory of human neoteny, often discussed in these columns, is an expression of this theme. It holds that a slowdown in maturation and rates of development has led to the expression in adult humans of a large suite of features generally found in embryos or juvenile stages of other primates. Not all these features need be viewed as direct adaptations built by natural selection. Many, like the "embryonic" distribution of body hair on heads, armpits, and pubic regions or the preservation of an embryonic membrane, the hymen, through puberty, may be nonadaptive consequences of a basic neoteny that is adaptive for other reasons—the value of slow maturation in a learning animal, for example.

Bard's proposal for "a unity underlying the different zebra striping patterns" (*Journal of Zoology,* London, vol. 183, 1977, pp. 527–39) follows D'Arcy Thompson's theme of a basic pattern stretched and pulled in different ways by varying forces of embryonic growth. These varying forces arise because the basic pattern develops at *different times* in the embryology of the three species. Bard thus combines the theme of transformed coordinates with the insight that substantial evolution can proceed by changes in the timing of development.

The basic pattern is simplicity itself: a series of parallel stripes deposited perpendicular to a line running along the embryonic zebra's back from head to tail—hang a sheet over a taut wire and paint vertical stripes on each side of it. These stripes are initially laid down at a constant size, no matter how big the embryo that forms them. They are 0.4 mm, or approximately 20 cell diameters, apart. The bigger the embryo, the greater the initial number of stripes. (I should point out that Bard's argument is a provocative model for testing, not a set of observations; no one has ever traced the embryology of zebra striping directly.)

The three zebra species differ in both number and configuration of stripes. In Bard's hypothesis, these complex variations arise only because the same basic pattern—the parallel stripes of constant spacing—develops during the fifth week of embryonic growth in one species, during the fourth week in another, and during the third week in the third species. Since the embryo undergoes complex changes in form during these weeks, the basic pattern is stretched and distorted in varying ways in the three species, leading to all the major differences in adult striping.

The three species differ most notably in patterns of striping on the rump and hind quarters. The Grevy's zebra (*Equus grevyi*) has numerous fine and basically parallel stripes in these rear regions. On Bard's model, the stripes must have formed when the back part of the embryo was relatively large. (The larger the part, the more stripes it receives, since stripes are initially formed at constant size and spacing.) In the embryology of horses, the tail and hind regions expand markedly during the fifth week *in utero.* If adults possess numerous, fine posterior stripes, they must form after this embryonic expansion of the rear quarters. (Unfortunately, no one has ever studied the early embryology of zebras directly, and Bard assumes that the intrauterine growth patterns of true horses are followed by their striped relatives as well. Since basic features of early embryology tend to be so conservative in evolution, true horses are probably fair models for zebras.)

The mountain zebra, *Equus zebra,* looks much like *E. grevyi* until we reach the haunch, where three broad stripes substitute for the numerous fine stripes of Grevy's zebra. Broad stripes on adults indicate initial formation on a small piece of embryo (where few stripes could fit), and later rapid growth of the piece (widening the stripes as the general area expands). If an embryo forms stripes in its fourth week, just before the posterior expansion that provides room for the many fine marks of Grevy's zebra, it will build the pattern of a mountain zebra during later embryonic growth.

Burchell's zebra, *Equus burchelli,* also has just a few broad stripes on its haunch. But, while the mountain zebra has fine stripes over most of its back and broad stripes only over the haunch, the broad stripes of Burchell's zebra begin in the middle of the belly and sweep back over the haunch. This pattern suggests an initial formation of stripes during the third week of embryonic growth. At this early stage, the embryo has a short, compact back, which later expands toward the rear in a broad, arching curve while the belly remains short. A stripe that initially ran vertically from spine to belly would be

BLACK HOLES...CLONING...

Explore the

Share the excitement of today's science with your family and prepare them for the technological marvels of the world they'll live in. The brand-new Revised Edition of the famous LIFE SCIENCE LIBRARY explains it all—from lasers that monitor minuscule changes in the shape of the earth to that incredible assembly of pumps, levers, energy converters and electrical circuits, the human body.

Did you learn about science from the original LIFE SCIENCE LIBRARY? Your family will find the same depth of authority in the Revised Edition. The same clarity. The familiar simplicity with which TIME-LIFE BOOKS explains complex ideas. The Mind... Energy... Drugs... The Body... Man and Space—each volume combines dazzling pictures and straightforward text to tell its story. And every volume in the Revised Edition reveals the latest developments, the current research, the theories that lie behind tomorrow's discoveries.

See for yourself—no obligation to buy.

Look through the introductory volume—The Mind for 10 days as our guest. Enjoy its intriguing exploration of the way you think...of what happens when you sleep...what pain really is...why you are using only the back part of your brain to read these words. This big, 200-page volume explains current knowledge on dreams, mental disorders, mind-expanding drugs, biofeedback. You can even experiment with baffling illusions that reveal how much—or how little—we know about what we see.

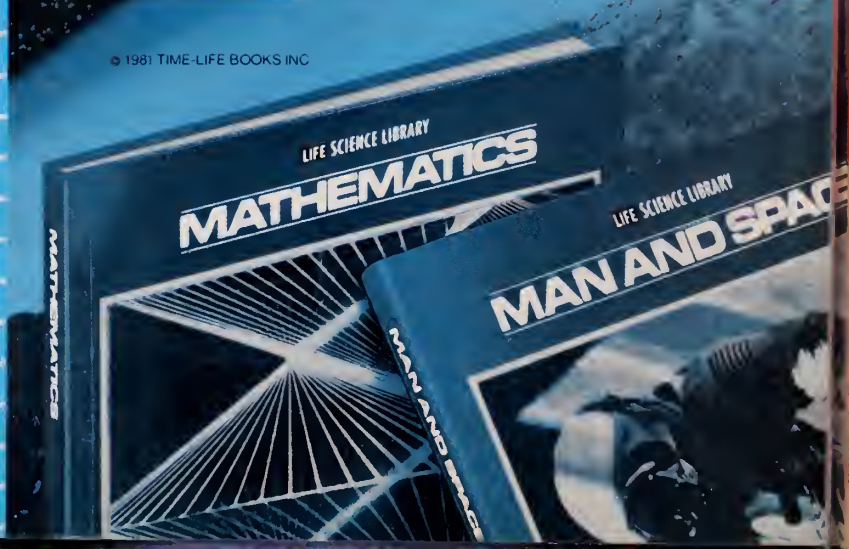
Begin a revealing adventure in the pages of The Mind. Simply mail the reply card today.

GO EXPLORING IN THE MIND FOR 10 DAYS FREE!

BONUS! Star Finder

Makes it easy to locate planets, stars and constellations. Fascinating—and FREE when you examine The Mind.

LIFE SCIENCE



© 1981 TIME-LIFE BOOKS INC

If card is missing, mail coupon to:
TIME-LIFE BOOKS
Time & Life Bldg.
Chicago, IL 60611

YES! I would like to examine The Mind. Please send it to me for 10 days' FREE examination along with my free Star Finder, and enter my subscription to the LIFE SCIENCE LIBRARY. If I decide to keep The Mind, I will pay $11.95 plus shipping and handling. I then will receive future volumes in the LIFE SCIENCE LIBRARY, shipped one volume at a time approximately every other month. Each volume is $11.95 plus shipping and handling and comes on the same 10-day free-examination basis. There is no minimum number of books that I must buy, and I may cancel my subscription at any time simply by notifying you.

If I do not choose to keep The Mind, I will return the book within 10 days, my subscription for future volumes will be canceled and I will be under no further obligation. The Star Finder is mine to keep in any case.

DFAD67

Name_____
(Please print)

Address_____ Apt._____

City_____

State_____ Zip_____

All orders subject to credit approval.

PROBE THE MIND FOR 10 DAYS FREE!



BONUS
Star Finder FREE

A planet, star and constellation locater you'll find both fascinating and easy to use. It's yours—FREE—just for examining The Mind

DFAD67

YES! I would like to examine The Mind. Please send it to me for 10 days' FREE examination along with my free Star Finder, and enter my subscription to the LIFE SCIENCE LIBRARY. If I decide to keep The Mind, I will pay $11.95 plus shipping and handling. I then will receive future volumes in the LIFE SCIENCE LIBRARY, shipped one volume at a time approximately every other month. Each volume is $11.95 plus shipping and handling and comes on the same 10-day free-examination basis. There is no minimum number of books that I must buy, and I may cancel my subscription at any time simply by notifying you.

If I do not choose to keep The Mind, I will return the book within 10 days, my subscription for future volumes will be canceled and I will be under no further obligation. The Star Finder is mine to keep in any case.

Name _____
(Please print)

Address _____ Apt _____

City _____

State _____ Zip _____

All orders subject to credit approval

Natural history



NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO 22 CHICAGO, ILL

POSTAGE WILL BE PAID BY ADDRESSEE

TIME
LIFE
BOOKS

Time & Life Building
541 North Fairbanks Court
Chicago, Illinois 60611

LASERS...SOLAR ENERGY...MIND CONTROL...

science explosion!



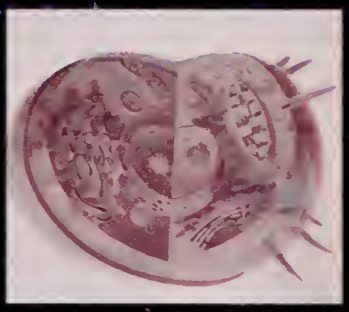
You'll see the new solutions science is exploring in the energy crisis.



Can you lower your blood pressure...just by thinking about it? You'll learn about intriguing biofeedback experiments.



You'll find out about new studies that reveal how early personality forms... how soon a baby recognizes voices...when a sweet tooth develops.



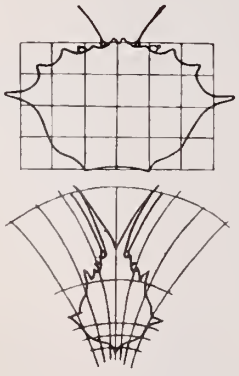
Did you know that your body is made up of 60,000,000,000,000 cells ...and that the characteristics of each one are determined by that incredible substance, DNA?

TIME LIFE BOOKS

pulled toward the rear as the embryo's top surface expanded backward while its belly grew little. An adult stripe, subject to such deformation in its embryonic life, would be broad and would run from the belly up and over the haunch—as in Burchell's zebra.

Thus, Bard can explain differences in rear striping of the three species as the results of deforming the same initial pattern at different times during normal embryonic growth. His hypothesis receives striking support from another source: the total number of stripes itself. Remember that Bard assumes a common size and spacing for stripes at the outset. Thus, the larger the embryo when stripes first form, the greater the number of stripes. Grevy's zebra, presumably forming its stripes as an embryo of five weeks and about 32 mm, has 80 or so stripes as an adult—or about 0.4 mm per stripe. Mountain zebras with a fourth-week embryo of some 14 to 19 mm in length have about 43 stripes—again about 0.4 mm per stripe. Burchell's zebra has 25 to 30 stripes; if they form in a third-week embryo some 11 mm long, we get the same value—about 0.4 mm per stripe.

As additional support, and a lovely example of the difference between superficial appearance and knowledge of underlying causes, consider an old paradox involving hybrid offspring between zebras and true horses. These animals almost always have more stripes than their zebra parent. "Common sense," based on superficial appearance, declares this result puzzling. After all, the state in between stripes and no stripes is few stripes. But if Bard is right about the underlying causes of striping, then this paradoxical result makes sense. The intermediate state between stripes and no stripes might well be a *delay* in the embryonic formation of stripes. If stripes then form at their common size and spacing upon a larger embryo, the resultant adult will have *more* stripes.



"Transformed coordinates" on the carapaces of crabs from two different genera demonstrate unity of form.

From *On Growth and Form*, by D'Arcy Wentworth Thompson/Cambridge University Press, 1917

If a unity of basic architecture underlies the diversity of zebra striping, then we must suspect that we are confronting a general pattern in nature, not just the "supreme abnormality" that Marianne Moore described. Darwin viewed horses in this light and recognized that the capacity for striping in all horses constituted a powerful argument for evolution itself. (As in last month's column, I use *horse* as a general term for all members of the family Equidae—true horses, asses, and zebras. When I wish to indicate Old Dobbin alone, I will speak of *true horses*.) If zebras are odd and perfect adaptations for camouflage, God might have made them as we find them. But if zebras merely actuate and exaggerate a potential property of all horses, then the occasional realization of striping in other horses—where it cannot be viewed as a perfected adaptation ordained by God—must indicate a community of evolutionary descent.

Darwin devoted much space in chapter 5 of the *Origin of Species* to an exhaustive tabulation of occasional striping in other horses. Asses, he found, often have "very distinct transverse bars . . . like those on the legs of a zebra." True horses often possess a spinal stripe, and some also have transverse leg bars. Darwin found a Welsh pony with three parallel stripes on each shoulder. And he noted that hybrids (with no zebra parents) were often strongly striped—an example of the common, and still mysterious, observation that hybrids often display ancestral reminiscences present in neither parent. "I once saw a mule," Darwin wrote, "with its legs so much striped that any one at first would have thought that it must have been the product of a zebra."

From this illustration of common, and often nonadaptive, patterns in all horses, Darwin drew one of his most powerful and passionate arguments for evolution—well worth quoting *in extenso:*

> He who believes that each equine species was independently created, will, I presume, assert that each species has been created with a tendency to vary, both under nature and under domestication, in this particular manner, so as often to become striped like other species of the genus; and that each has been created with a strong tendency, when crossed with species inhabiting distant quarters of the world, to produce hybrids resembling in their stripes, not their own parents, but other species of the genus. To admit this view is, as it seems to me, to reject a real for an unreal, or at least for an unknown, cause. It makes the works of God a mere mockery and deception; I would almost as soon believe with the old and ignorant cosmogonists, that fossil shells had never lived, but had been created in stone so as to mock the shells now living on the seashore.

The same theme also suggests an answer to the title of last month's essay: "What, if Anything, Is a Zebra?" I advanced the argument that zebras may not form a group of closest relatives, but a set of different horses that had either evolved stripes independently or inherited them from a common ancestor (while asses and true horses lost them). Bard's hypothesis lends support to this conjecture because it suggests that the underlying pattern of zebra striping may be so simple that all horses include it in their repertoire of development. Zebras, then, may be the realization of a potential possessed by all horses.

Finally, moving from the sublime to the merely interesting, Bard proposes a solution to the primal dilemma and argues that zebras are black animals with white stripes after all. The white underbelly, he points out, is a lousy argument because many fully colored mammals are white underneath. Color may be generally inhibited in this region for reasons at present unknown. Mammals do not have their colors painted on a white background. The basic issue may then be rephrased: Does striping result from an inhibition or a deposition of melanin? If the first, zebras are black animals; if the second, they are white with black stripes.

Biologists often look to teratologies, or abnormalities of development, to solve such issues. Bard has uncovered an abnormal zebra whose "stripes" consist of rows of dots and discontinuous blotches, rather than coherent lines of color. The dots and blotches are white on a black background. Bard writes: "It is only possible to understand this pattern if the white stripes had failed to form properly and that therefore the 'default' color is black. The role of the striping mechanism is thus to inhibit natural pigment formation rather than to stimulate it." The zebra, in other words, is a black animal with white stripes.

Stephen Jay Gould teaches biology, geology, and the history of science at Harvard University.

Come share Costa Rica. From an active volcano to the friendly people.





Now 50% more for your dollar.

Peaceful Costa Rica is truly a country of contrasts. You can have the unforgettable experience of standing next to an active volcano. Yet there's no experience quite like the gentle hospitality of Costa Rica's friendly people.

Spend a day driving through beautiful alpine scenery to the very edge of the crater of Irazu Volcano. Then return to San Jose by way of Cartago, the old capital founded by the Spanish in 1564.

And during your stay in San Jose, mingle with the friendly people at their local markets and fiestas as well as at your own hotel. You're sure to appreciate the gentle hospitality that's hard to find anywhere else.

Four nights accommodations, a visit to Irazu Volcano and a city tour of San Jose start as low as $87 (ITOEA1HDCR) per person double occupancy plus air fare. And with Costa Rica's favorable exchange rate, now you get 50% more for your dollar.

For more information on Costa Rica, call your travel agent or write: COSTA RICA TOURIST BOARD, Box E12, 3709 N. W. 36th St., Miami, Florida 33142.

COSTA RICA

we have so much to share

The Elusive Eureka

A puzzling fossil provides a lesson in the scientific method

by Niles Eldredge

The tendency of scientists to make pronouncements from remote Olympian heights lends credence to the charge that science is just another belief system, no different from any other. The current efforts of fundamentalist Christians to inject the biblical story of Creation into biology curricula across the nation exploit this very impression. Creationist cries of "equal time" appeal to people's sense of fair play because science, like religion, often appears authoritarian. And it is true that science has become so complex that no one can hope to grasp it all. Most of us are content to believe that the earth is round, even though we are personally unable to make the necessary observations that verify it. But before a scientific idea can earn this kind of routine acceptance, it must be subjected to the scrutiny of the "scientific method."

The scientific method is not some mysterious form of higher cerebration. Its principle is simply that our ideas about the universe—how it is constructed, how it came to be—must conform to our observations. Scientists test an idea by predicting what they should find if it is true, and their understanding of the natural world is refined in a constant interplay of ideas and observations. This very human exercise is very different from the unquestioning acceptance of "revealed truth." A scientist is prepared to evaluate any new piece of evidence, even if it challenges an orthodox theory. Sometimes the theory will be discarded or modified; sometimes the evidence will be thrown out of court. But in either case something will have been gained. I have here a modest example of how the system works; perhaps it will give an idea of what scientists actually do for a living.

No one (presumably) would dare write an article for a science magazine without being reasonably sure of his or her ground. So when I reported in the July 1980 issue of *Natural History* on distribution patterns of Devonian trilobites in the Southern Hemisphere, I was relying on 150 years of accumulated paleontological research, as well as ten years of my own contemplation of these fossils. The picture I presented was a neat one. Trilobites are extinct relatives of crabs and shrimps; those that I wrote about lived in what was evidently a cold-water habitat during the Devonian period, 395 to 345 million years ago. Their fossils are most numerous in Andean South America from southern Peru south through Bolivia and Argentina. They also occur in less exuberant numbers in the Amazon Basin, portions of southern Brazil and Uruguay, the Falkland Islands, and South Africa. The most reasonable explanation for this distribution is that there once was a great, partly submerged landmass, which geologists call Gondwana, that broke up to form South America, Antarctica, Africa, India, and Australia. The widely scattered localities that yield these cold-water Devonian fossils were once much closer together, and all were south of 60° south latitude.

As the article for *Natural History* was in its final editorial phase, however, I received a letter from Alfonso Segura Paguaga, a Central American geologist living in Esparza, a rural area of Costa Rica near the Pacific coast city of Puntarenas. I was startled at his announcement of the discovery of a Devonian trilobite in Costa Rica. No rocks even remotely as old had ever been found there. Paguaga wanted me to examine the specimen, proposing to name it *Phacops esparsocostariccensis.* I hurriedly wrote back that I would be delighted to work on the trilobite, the possibility of a bona fide discovery lurking in the back of my mind.

Paguaga arrived in my office with the trilobite, as well as fossils from four separate outcrops in the environs of Esparza. Eagerly unwrapping the trilobite first, I was flabbergasted. There before me lay a typical example of *Metacryphaeus tuberculatus*—a very common trilobite, indeed, but one known only from southern Peru and Bolivia. "Were I not informed," I wrote rather formally in my report to Paguaga, "that the specimen came from Costa Rica, I would without hesitation say it came from the region of Padilla, Bolivia."

Two things were puzzling about the fossil. The first was its age: as far as I knew, Venezuela and Colombia in South America, and Mexico in North America, were the closest places to Costa Rica that had ever produced a Devonian trilobite. Second, the specimen was not the type of trilobite we would expect to find even in those areas. Trilobites from northern South America are of the same basic stripe as our own Northern Hemisphere Appalachian trilobites—and radically different from those, such as *Metacryphaeus,* that lived in the cold seas that bathed Gondwana.

The geologic history of Central America and the Caribbean is extremely complex and as yet only partly unraveled. What we seemed to have was

Choose one of these five sets and save up to $216.15

You simply agree to buy 4 books within the next two years.



The Compact Edition of The Oxford English Dictionary

The "most complete, most scholarly dictionary of the English language"—*The Christian Science Monitor.* Through photo-reduction, the original 13-volume set has been reproduced in this two-volume Compact Edition. Magnifying glass included.

$125.00	Publisher's price
-$105.05	Your savings
$ 19.95	Book-of-the-Month Club price



The Encyclopedia of Philosophy

The most comprehensive encyclopedia of philosophy ever published. this set traces ancient, medieval, modern, Eastern and Western thought. An essential and rewarding reference source for home libraries.

*While the publisher's price has risen from $125 to $150, our special price remains the same.

$150.00	*Publisher's price
-$130.05	Your savings
$ 19.95	Book-of-the-Month Club price



The American Language by H. L. Mencken

Mencken's masterpiece and the standard work on the subject: a robust and witty three-volume study of English as it has evolved in the United States by borrowing words, phrases and slang from a rich variety of sources.

$70.00	Publisher's prices total
-$60.00	Your savings
$10.00	Book-of-the-Month Club price



The Story of Civilization by Will and Ariel Durant

For more than a generation, Will and Ariel Durant have been tracing the continuity of our history—economic and political organization, science and art, religions, philosophies, customs and manners—to show the foundations of society today. Now complete, the Durants' 11-volume masterwork is history come alive. The enormous work covers ancient and modern civilization, including Oriental as well as Western history. With clarity and authority, the Durants illuminate "the steps by which man passed from barbarism to civilization." This set is a magnificent centerpiece for any home library, and one of the most useful sources of knowledge that the modern reader can possess.

$241.10	Publisher's prices total
-$216.15	Your savings
$ 24.95	Book-of-the-Month Club price



The Nine Beethoven Symphonies & The Five Piano Concertos/Ashkenazy

A special offering of two of the most acclaimed recordings in years. Sir Georg Solti conducts The Chicago Symphony in the nine-record set of Beethoven's complete symphonies, hailed by *Time* as "a glorious musical combustion." In collaboration with Vladimir Ashkenazy, Solti and the Chicago Symphony perform Beethoven's five concertos. *High Fidelity* calls it "a major addition to the Beethoven discography." Available in 13 records or 8 cassettes.

$111.74	List prices total
-$ 95.79	Your savings
$ 15.95	Book-of-the-Month Club price

Prices shown are publishers' U.S. prices. Outside the U.S., prices are generally somewhat higher.

Benefits of Membership. Membership in the Book-of-the-Month Club begins with your choice of the extraordinary works offered here. Because our prices are generally lower than the publishers', you will save on works such as these throughout your membership as well as on the finest new fiction and nonfiction titles. In fact, the longer you remain a member, the greater your savings can be. Our Book-Dividend® plan, for which you become eligible after a brief trial enrollment, offers at least 70% off the publisher's price on art books, reference works, classics, books on cooking and crafts, literary sets and other contemporary works of enduring value. Nevertheless, all Book-of-the-Month Club books are equal in quality to the publisher's original; they are not condensed versions or cheaply made reprints.

As a member you will receive the *Book-of-the-Month Club News*® 15 times a year (about every 3½ weeks). Every issue reviews a Main Selection and 150 other books that we call Alternates, which are carefully chosen by our editors. If you want the Main Selection, do nothing. It will be shipped to you automatically. If you want one or more Alternates—or no book at all—indicate your decision on the Reply Form and return it by the specified date. *Return Privilege:* If the *News* is delayed and you receive the Main Selection without having had 10 days to notify us, you may return it for credit at our expense. *Cancellations:* Membership may be discontinued, by either you or the Club, at any time after you have purchased 4 additional books. Join today. With savings and choices like these, no wonder Book-of-the-Month Club is America's Bookstore.®

Book-of-the-Month Club, Inc., Camp Hill, Pennsylvania 17012 **A113-8**

Please enroll me as a member of Book-of-the-Month Club and send me the work I have checked below, billing me for the appropriate amount, plus shipping and handling charges. I agree to buy 4 books during the next two years. A shipping and handling charge is added to each shipment.

CHECK ONE BOX ONLY

- ☐ 912. Compact OED **$19.95**
- ☐ 913. The Story of Civ. **$24.95**
- ☐ 915. American Language **$10**
- ☐ 917. Ency. of Philosophy **$19.95**
- ☐ 932. Beethoven (13 Records) **$15.95**
- ☐ 933. Beethoven (8 Cassettes) **$15.95**

Mr.
Mrs. **I-61**
Miss
(Please print plainly)

Address Apt

City

State Zip

BOOK-OF-THE-MONTH CLUB®
America's Bookstore® since 1926

an "island" of Devonian Gondwana—a portion of Andean South America that had somehow become detached and incorporated as an exotic chunk into what later became Costa Rica. A radically new view of shifting fragments of continental plates colliding to form portions of Central America started to take shape in my mind. It was too late to stop the *Natural History* presses, but I began to envision a quick report to *Science* or some other prestigious "what's the latest development in science" journal.

But there was a small fly in the ointment. Paguaga said he got the trilobite from a small boy who had brought it to school. The boy had found it on a local roadside. If we were to tell the world of an exotic Devonian "island," we had to be able to point to a mass of rock and say, "There it is." Another specimen Paguaga brought with him seemed promising: a chunk of brown siltstone about the size of a silver dollar. It had shell fragments that looked the right age on one side, and a gorgeous fossil, which I took to be a previously unrecorded variety of phyllocarid, a type of crustacean especially well known in Devonian rocks. About an inch long, the symmetrical structure was elaborately sculptured with a variety of bumps and furrows reminiscent of, although a bit more complicated than, the carapaces of known phyllocarids. We seemed to be in good shape, but Paguaga understood the necessity for ironclad evidence that the trilobite was indeed a native of Esparza.

Shortly after his return home, Paguaga went to work, and I was soon bombarded with packages of Costa Rican fossils. Concentrating on the outcrop that had produced the crustacean, he found more than fifty complete fossils and shipped them all to New York. To my chagrin, all proved to be clams and snails no older than twenty or thirty million years—very much the sort of thing one was supposed to find in Costa Rica.

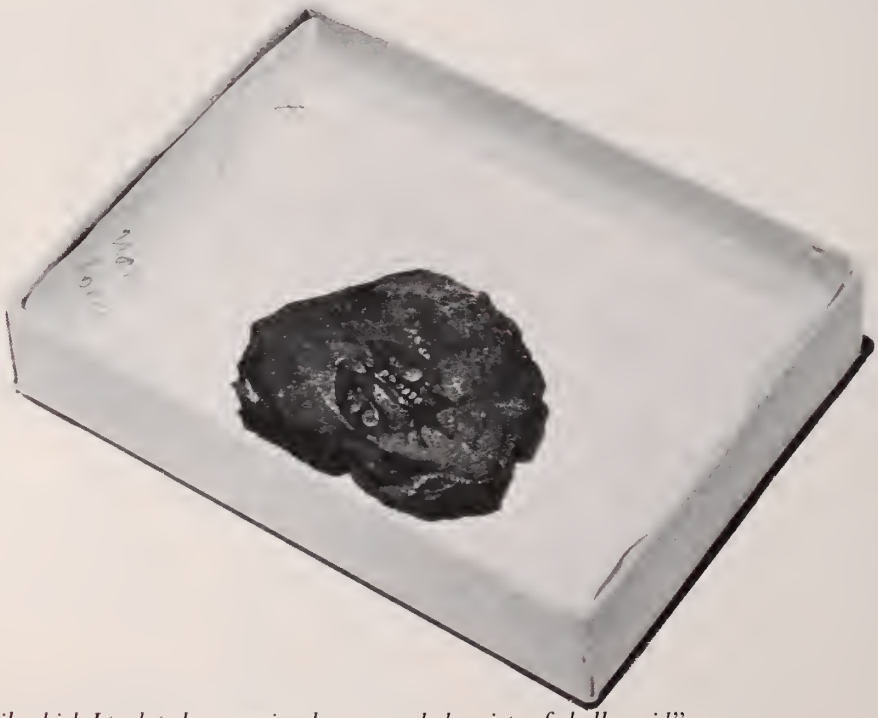
With my doubts deepening, I retrieved the "crustacean" from the collection of Costa Rican fossils, stared at it hard, and realized it was not a phyllocarid after all. It was (and I am no botanist) apparently some sort of nut or seed pod. Groaning, I realized my enthusiasm had carried me away. I had fantasized a Tertiary fruit into a Devonian crustacean! All of a sudden I was quite glad I hadn't batted out a note to *Science* trumpeting our wonderful discovery.

The real story of the Esparza trilobite is not exactly fraught with scientific significance. It turned out my first suspicion about the origin of the fossil was right. An American, leaving La Paz, Bolivia, to live in Costa Rica, bought the trilobite from an "old Indian" as a souvenir. (I hear that these trilobites have been for sale all over La Paz in recent years.) He had a minor car accident on a Costa Rican road one day, and the trilobite was lost—only to be found by the little boy. All the details were uncovered by Paguaga—a dogged truth seeker if ever there was one—who advertised in the papers and tracked down the American, still living in Costa Rica. Of the thousands of Andean fossils in my office, none has taken a more circuitous route from the mountains of Bolivia to our labs in New York.

The whole episode, as absurd as it may seem, really does show how science works. The misplaced trilobite challenged several longstanding notions I had confidently recounted in my article for *Natural History.* Either the ideas or the trilobite had to give.

In the end, I was sorry not to have been a party to a real discovery. It would have been nice to have had the chance to exclaim "Eureka!" the way scientists are popularly supposed to do. You know the image. After years of tedious measurement, a new generalization on the properties of matter suddenly dawns on the patient physicist; after much careful planning, the pith-helmeted coot in khaki shorts bags a "hitherto-unknown-to-science" butterfly in the depths of Amazonia. Eureka! But, alas, eurekas are damn hard to come by. The true stuff of science remains the sure and steady checking of ideas against worldly realities.

Niles Eldredge is a curator in the Department of Invertebrates at the American Museum of Natural History.



". . . a gorgeous fossil, which I took to be a previously unrecorded variety of phyllocarid"

Coxe-Goldberg Photography, Inc

The Onkyo TX-4000.
It will tame you, thrill you, tantalize and transport you.



The Onkyo TX-4000 Quartz Synthesized Tuner/Amplifier is one of the most perfect stereo receivers we've ever designed. Nothing else in its price range provides the brilliant purity, dynamic headroom, and full excitement of its sound.

The Onkyo TX-4000 brings tuning accuracy to a new level of precision . . . with an advanced approach to quartz-synthesized digital tuning. And the amplifier section provides all the dynamic headroom demanded by today's audiophile recording techniques. Onkyo's exclusive Dual-Super-Servo system makes it possible, by allowing the power supply to perform as if it were 50-times larger. And there's more . . . LED power metering, memory to pre-set 6 AM and 6 FM stations . . . and elegant styling with a flip-down control panel.

All combine to make The Onkyo TX-4000 a tuner/amplifier you will definitely want to audition . . . and then own. Hear it now at your Onkyo dealer.

Onkyo USA Corporation, 42-07 20th Ave., Long Island City, N.Y. 11105. (212) 728-4639. ONKYO®

Debut of an Interstellar Bubble

A new, fourth type of emission nebula is found

by Stephen P. Maran

The Rosette nebula is a beautiful glowing gas cloud that surrounds a cluster of young hot stars in the constellation Monoceros, about 5,200 light-years from the earth. It has long puzzled astronomers, but a consensus has now been reached: the Rosette is a large interstellar bubble.

The term *interstellar bubble* was itself invented only six years ago, a decade after the first suggestion that such objects might exist. It refers to a type of emission nebula characterized by a low-density cavity formed by winds from one or more stars that push away the surrounding interstellar gas. The displaced gas forms a thick shell around the cavity, like the piles of snow at the side of a freshly plowed road.

Emission nebulae are clouds of cosmic gas that shine by their own light, rather than by reflecting the light of stars. Until now, they were classified into three types: H II regions, planetary nebulae, and remnants. H II regions consist of interstellar gas that is heated and made to glow by the ultraviolet rays from adjacent large hot stars. The Orion nebula (*Natural History,* May 1980) is a good example. Planetary nebulae, such as the Ring nebula in Lyra, are formed from the outer layers of red giant stars. After the layers are ejected, only the small blue cores of the once grossly extended giants remain. Remnants consist of rapidly expanding material from exploding stars (novae and supernovae). The Crab nebula is the best-known supernova remnant.

Interstellar bubbles, now recognized as a fourth type of emission nebula, are like H II regions and planetary nebulae in that they shine because the stars within them stimulate them with ultraviolet light. However, this type of emission nebula differs from the other types in being shaped by the winds from those stars.

The recognition of interstellar bubbles as a distinct type of nebula can be traced back to an investigation of the Rosette nebula by the radio astronomer T. K. Menon at Green Bank, West Virginia, in 1961. He mapped the Rosette with an 85-foot radio telescope of the National Radio Astronomy Observatory at Green Bank. Although Menon did not himself develop the theory of interstellar bubbles, his map was the first of several clues that eventually led astrophysicists to identify this new type of nebula.

At the time of Menon's study, the Rosette nebula was classified as an H II region. In fact, a photograph of the nebula was used to illustrate the concept of an H II region in a college astronomy textbook published in the same year that Menon mapped the Rosette. The caption for the photograph did not mention the striking difference between the Rosette and other H II regions such as the Orion nebula, although the difference was readily apparent. The Rosette nebula seems to have a relatively darker central region, surrounded by a brighter zone, whereas the Orion nebula has a bright center.

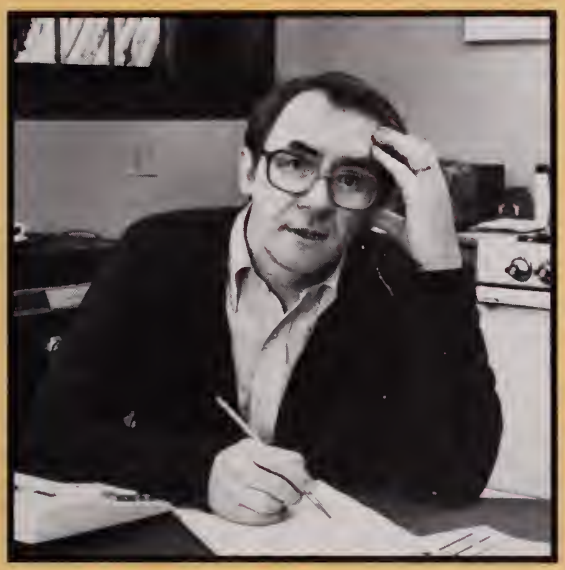
Menon wished to explore the nature of the dark central region in the Rosette nebula. Telescopic photographs record nebular light that is produced by gas with temperatures of about 4,000° to 10,000°C. The "hole" seen in photographs of the Rosette might be due, Menon reasoned, either to a substantial deficiency of gas or to the presence of gas just as dense as that found in the bright rim of the nebula but at a much higher temperature. Nebular gas of a few hundred thousand degrees or hotter would not glow noticeably in visible light but would emit strong radio waves. Thus, if the radio map of the Rosette were to show a bright central region, the presence of much superhot gas would be indicated, but if the map showed a dim hole, like that in the telescopic photographs, a deficiency of gas would be confirmed. A third possibility, that the apparent hole might be due to a cloud of dark interstellar dust, is ruled out because the star cluster at the center of the Rosette is plainly visible on the photographs.

After scanning the Rosette nebula with the 85-foot Green Bank radio telescope, Menon presented the results in the form of a contour map of radio-brightness levels that resembles a geographer's contour map of terrain altitudes. At the center of the series of closed solid curves on this map, there appears a small, dashed loop. The dashes indicate a dip in the middle of the nebula, rather than a peak in radio brightness. Thus there is indeed a deficiency of gas in the center of the Rosette. The observations were incapable of determining just how hot and thin the residual gas in the aforementioned hole seen in the photographs might be.

Subsequent observations made with

Some people feel...

"My house was robbed. My neighbor says I should 'pad' my insurance claim. Why should I have to lie to come out even?"



That's why we want you to know...

You don't have to lie to come out even. Your neighbor, like some homeowners, may be confused about what homeowners insurance actually provides for loss of contents. Some think it guarantees "replacement value." In fact, most homeowners insurance policies provide "cash value."

There is an important difference. "Replacement value" means the actual cost to replace—brand new—the stolen item. "Cash value" means the current *depreciated* amount the item was worth *at the time of* the loss.

For example, if your stereo is stolen, a standard homeowners policy would give you the "cash value." Assume you paid $1,000 for the stereo ten years ago; today it may be worth $500. So you would get $500 from your insurance company, minus the deductible you have selected.

Policies are available that offer "replacement value" or "agreed value." But, of course, these kinds of coverage are more expensive than the conventional homeowners policy. Which kind of coverage is right for you? Most people opt for the conventional homeowners policy. In the event of a major disaster, like a fire or a windstorm, it enables you to put your home together again. And in the event of a burglary, it will give you the fair "cash value" of the item you lost.

For more information, consult your insurance agent. Review your present coverage and ask about the kind of protection you feel you need. Determine costs. Check to see if your standard homeowners policy provides limited coverage on items such as paintings, prints, cameras, jewelry, silverware, or furs. If so, you may want additional coverage, or "floaters," for those valuables.

A frank talk with your agent can prevent surprises and create a better understanding of what you can reasonably expect from your insurance policy when you have a claim.

We're working to keep insurance affordable.

This message presented by the **American Insurance Association,** 85 John Street, NY, NY 10038

WHICH EXERCISER PROVIDES THE MOST IDEAL C.V. EXERCISE ?



Exercise Bike ☐
Treadmill ☐
Nordic Track ☑

NordicTrack

Jarless, Total-Body Cardiovascular Exerciser

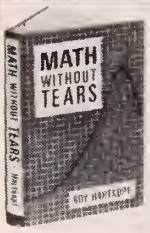
Duplicates XC Skiing for the best motion in fitness.

Better than treadmills . . . No body-damaging, jarring motion. Doesn't neglect the arms and shoulders. NordicTrack is smaller, lighter, more portable, doesn't require motors and is very quiet.

Better than bikes . . . Stand-up position provides far more uniform leg muscle loading. Makes high heart rates easier to attain. Arms and shoulders exercised just as effectively as the legs. More muscle mass involved. Adjustable arm and leg resistance.

PSI 124 L Columbia ct. Chaska, MN 55318
toll free 1-800-328-5888 MN. 612-448-6987

MATH WITHOUT TEARS



Using non-technical language and a light touch Roy Hartkopf gives you a basic understanding of many everyday applications of mathematics. He takes the reader from simple counting to trigonometry and calculus, emphasizing the practical aspects of math. Humorously written.

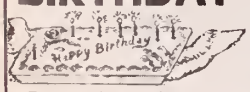
Learn math in the comfort of your own home at minimum cost.

Order Now $10.95 plus $1.10 hdlg
EMERSON BOOKS, INC.
Dept. 839-F Buchanan, N.Y. 10511
10 Day Money Back Guarantee

WE SHIP ANYWHERE IN U.S.A.

Featured on PM Magazine TV Show

BIRTHDAY CAKES



Anniversary, Best Wishes, etc.

For students, friends, loved ones. Delicious cake with candles, plates, forks, knife and birthday (or other) card. Free Brochure

BALLOON-IN-A-BOX



Helium filled mylar balloon with colorful ribbon saying "Happy Birthday" (Happy Anniversary, Congratulations, Get Well, etc.) A real surprise. Stays up for days!

Featured on PM Magazine TV Show

Free Brochure

R.D. Grimm Mktng., Dept. 52 Write or Phone
246 E. 46th St., N.Y.C., N.Y. 10017 (212) 687-0278

a more advanced radio telescope confirmed Menon's findings, and we now know that the Rosette nebula consists of a central cavity almost seventy light-years in diameter surrounded by a bright, roughly spherical shell of gas, about twenty-three light-years thick and containing enough material to make over 11,000 suns. The nebula has attracted the attention of many astronomers since Menon's study, and a variety of ideas have been proposed to explain its unusual form.

The first of these ideas was that as the young stars at the heart of the nebula were formed, their ultraviolet radiation began traveling out through the surrounding gas, heating and ionizing it and also producing a shock wave that pushed the gas outward. Mathematical analysis, however, soon showed that any such shock wave would be too weak to produce a cavity of the observed proportions.

Two other theories, which appeared to be based on sounder principles, were proposed in 1966 by William G. Mathews, a young postdoctoral fellow at the Mount Wilson and Palomar Observatories in Pasadena, California. One theory he advanced was the idea that the hole in the Rosette nebula had resulted from the formation of the star cluster in its center. In other words, according to this "cavitation" theory, the missing gas had condensed to form the observed stars. Mathews's second theory, now recognized as the first proposal for the existence of interstellar bubbles, was that the hottest stars in the Rosette cluster have powerful, high-temperature stellar winds, which sweep away the surrounding gas, thus producing the hole.

One point that favors the cavitation theory is that the amount of missing gas (which can be estimated by assuming that the hole in the Rosette nebula was once filled by gas as dense as that now found in its bright rim) is about equal to the total mass of the stars in the cluster at the nebula's center. Since nature abhors a vacuum, the cavitation theory predicts that the gas in the rim is now pouring into the hole. Specifically, an inflow of gas at a velocity higher than the speed of sound (about six miles per second in the nebula as compared with one-fifth of a mile per second on Earth) is predicted.

Mathews's second theory, which ascribes the hole in the Rosette nebula to the action of hot stellar winds, has been updated by several other astrophysicists. In its revised form, the wind theory predicts that the bright gas on the rim of the hole is flowing outward at a speed above the speed of sound. According to this theory, since the hole is filled by outward-blowing winds, it is also predicted that the thin gas in the hole is at a temperature of about 500,000°C.

At the time his first two theories were proposed, Mathews recognized that both of them invoked processes not actually known to occur. There were no other known cases of holes formed in nebulae as a result of the condensation of stars nor were stars of the type found in the center of the Rosette nebula known to possess powerful stellar winds. In 1967, these uncertainties led Mathews to propose a third theory.

According to this theory, the central region of the Rosette nebula was originally filled by a mixture of gas and microscopic particles of interstellar dust. Such dust is found, for example, mixed in with the shining gases of the Orion nebula. Mathews proposed that the dust was electrified by ultraviolet light from the centrally located stars and that it was pushed outward from the center of the nebula by the pressure of light from the newly formed stars in the cluster. This process would be analogous to the formation of the dust tail of a comet, which occurs when sunlight pushes tiny dust particles away from the head of the comet. The outward-moving dust of the Rosette would then in effect drag the adjacent gas outward with it, accounting for the formation of the central hole. This theory predicts that the gas on the rim of the hole is flowing outward, as in the wind theory, but at less than the speed of sound.

In summary, two of Mathews's theories predict outward flow although they differ from each other in whether the flow is subsonic or supersonic. Mathews's other theory predicts supersonic inward flow. Thus no two theories agree on both the direction and the speed of the gas flow, and so observational tests should be possible. This circumstance inspired numerous observations including those of astronomers at the Cerro Tololo Inter-American Observatory in La Serena, Chile; the Marshall Space Flight Center in Huntsville, Alabama; the University of Manchester in England; and the Algonquin Radio Observatory in Ottawa, Canada.

These many studies of the Rosette nebula came to a common conclusion. Speeds well above the six miles per second velocity of sound were observed in the nebula. Hence the one theory that

involves subsonic flow, Mathews's third proposal in 1967 that the cavity was produced by the pressure of starlight, has been eliminated.

You might think it an elementary matter to determine whether the supersonic flow in the Rosette is directed inward or outward, but such is not the case. The velocity is determined by measuring the Doppler shifts of spectral lines. Due to the Doppler effect, gas moving away from the earth emits lines that are red-shifted, while gas approaching the earth emits blue-shifted lines. The size of the Doppler shifts observed in the spectrum of the Rosette nebula tells us that the flow is supersonic. If the nebular gas were flowing outward, then gas on the near side of the nebula would produce blue-shifted lines; if the gas were flowing inward, then blue-shifted lines would come from the gas on the far side. But since the nebula is transparent and light from both its near side and far side is recorded simultaneously with a spectrograph, when we find a blue-shifted line, we do not know whether it comes from the front or the back of the Rosette. We know how *fast* the gas is going, but not which *way* it is going.

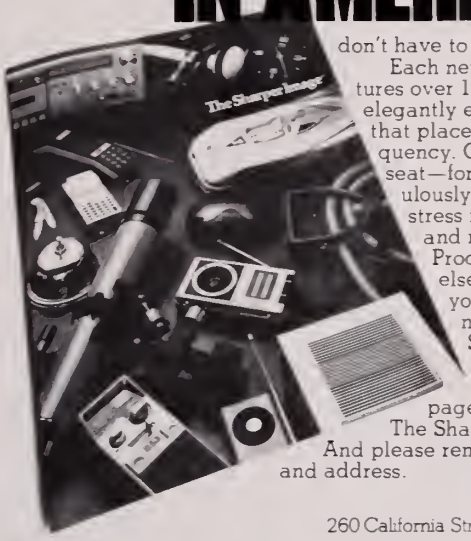
One team of astronomers found indications that the flow in the Rosette is inward, as predicted by the cavitation theory, but this result is not very persuasive. A more conclusive finding comes from studies with the International Ultraviolet Explorer (IUE) satellite. These observations show that the two brightest stars in the Rosette nebula actually do have strong stellar winds.

According to Peter Conti, an expert on stellar winds and interstellar bubbles at the University of Colorado in Boulder, the brightest star in the Rosette has more than fifty times the mass of the sun and is nearly a million times brighter. Its wind alone may have been sufficient to blow out the large cavity we now observe in the nebula.

A final test, now being carried out with the IUE, is attempting to measure the temperature of the gas in the hole of the Rosette. If, as the wind theory predicts, this thin gas has a temperature of about 500,000°C, then our recently formed conviction that the Rosette nebula is an interstellar bubble will be vindicated.

Stephen P. Maran is a senior staff scientist in the Laboratory for Astronomy and Solar Physics at NASA's Goddard Space Flight Center in Greenbelt, Maryland.

THE CLEVEREST EXECUTIVE TOYS IN AMERICA.



Fun It's something you don't have to give up when you grow up. Each new Sharper Image catalog features over 100 intriguing products. Like an elegantly engineered cordless telephone that places calls over a private FM frequency. Or a genuine European racing seat—for your office or den. Plus miraculously efficient home gyms, portable stress monitors, and the latest video and microcomputer high technology Products so new you won't see them elsewhere (and product categories you never knew existed). Plus internationally known names like Seiko—at world-beating discounts. For a full year's subscription (5 or more editions) to our 36-page color catalog, send one dollar to The Sharper Image at the address below. And please remember to include your own name and address.

THE SHARPER IMAGE

260 California Street Dept. 144 San Francisco, CA 94111

©1981 The Sharper Image

dis·co



Webster's New Collegiate Dictionary. It's where the words live.

America's best-selling dictionary doesn't just define words—it brings words alive. So you can feel the frenetic beat of a "disco," get the tangy taste of "wassail," and sense the bitter emptiness of "rip-off." For this is the dictionary that offers thousands of quotations and usage examples plus scores of illustrations—all arranged to make meanings clearer than ever. Just $12.95 wherever books are sold. Merriam-Webster, Springfield, MA 01101.

FROM MERRIAM-WEBSTER®

© G & C MERRIAM 1977

Volcanoes and the Maya

In A.D. 260, a catastrophic eruption drove the southeastern Maya from their lands in what is today El Salvador. A Pompeii-like site, buried by a smaller eruption three centuries later, tells the story of how the country was resettled

by Payson D. Sheets

The hazards of living in a volcanically active area were dramatically illustrated by the May 18, 1980, eruption of Mount St. Helens in Washington. The lateral blast killed dozens of people and destroyed 150 square miles of forest, while the ashfall disrupted agriculture and transportation hundreds of miles downwind. Less obvious than the disadvantages of living in a volcanic area are the advantages, which include the fertile soils that develop as volcanic ash weathers. In fact, the agricultural productivity of the state of Washington owes much to the periodic eruption of the Cascade volcanoes during the past 10,000 years. My recent archeological research in El Salvador has revealed a similar balance of risks and benefits for the southeastern Maya people, who lived along the volcanic axis of Central America. About A.D. 260, a massive explosion buried these highlands in ash, forcing the Maya to abandon them for decades—up to two centuries in the worst hit areas. One small area in this region was struck by three additional eruptions in the years that followed. These various eruptions differed in terms of the size of the area devastated and the nature of the tephra (ash and other materials) blasted into the air, but in each instance people showed a dogged determination to reoccupy the lands affected, thereby reaping the benefits of volcanic activity. El Salvador's volcanoes not only influenced the course of Maya civilization but also preserved, for archeologists, a very detailed record of prehistoric times.

The earliest evidence of an agricultural people in El Salvador is a site dating back to about 1200 B.C., although there were migratory hunter-gatherers in the area thousands of years before then. Excavations directed by Robert Sharer of the University of Pennsylvania have shown that this site, Chalchuapa in western El Salvador, was first settled by people from the Pacific coastal plain of what is now Guatemala. In addition to exploiting the fertile soils of the broad Chalchuapa Valley, these people regularly drew upon the massive obsidian outcrops at Ixtepeque, a volcano thirty miles to the northeast. Raw or only roughly shaped pieces of volcanic glass were hauled into Chalchuapa, where conical "macrocores" from which flakes could be struck, as well as various cutting and scraping tools made from such flakes, were manufactured for domestic consumption and long-distance trade. The colony of Chalchuapa prospered and grew in size after it came under the direct cultural and economic influence of the Olmec civilization about 900 B.C. A major trade route ran from Chalchuapa along the Pacific coast of Guatemala and southern Mexico and into the Olmec heartland, centered on Mexico's Gulf coast. Besides obsidian, numerous commodities—including jade, hematite, and perhaps perishables such as cotton, cacao, salt, and quetzal feathers—were traded along this route.

By about the time of Christ, the region of El Salvador was densely populated, with more than 125 people per square mile. The bulk of the population were farmers, who cultivated both irrigated and unirrigated fields. Corn and beans were probably the staples, supplemented by a variety of root and tree crops and a few wild plants and animals. From what we know about parallel developments in other regions and the limited amount of direct archeological evidence, we can conclude that Maya society in El Salvador was stratified, with an elite composed of affluent decision makers. In the towns, whose central areas were dominated by pyramids and plazas, a middle class of artisans and government functionaries was emerging.

Some of the earliest Maya hieroglyphic and calendric inscriptions are from El Salvador and adjacent southern Guatemala, showing that this was one of the most advanced Maya areas at the time. This progressiveness can be attributed, in part, to the highly fertile soil that had developed in the first millennium B.C., a period of relative volcanic quiescence. Previously deposited tephra had had time to "weather"—that is, to undergo physical and chemical change through the process of plant growth and decay and the action of the elements. Agronomist Gerald Olson of Cornell University has discovered that when well weathered, this volcanic soil has an excellent capacity to retain moisture and is rich in organic matter and in the phosphates and nitrates important for seed crops such as maize.

Jade was one of the principal trade items in Maya times. This chest ornament of the Late Classic period (A.D. 600–900) came from Nebaj in the Guatemalan highlands, not far from the jade source.

Lee Boltin



The region's volcanic quiescence was shattered by the sudden eruption in about 260 of Ilopango volcano, which has been studied by Virginia Steen-McIntyre of Colorado State University. Under the northwest corner of Lake Ilopango—a lake formed as a result of more ancient volcanic activity—a vent opened up and began spewing massive amounts of tephra into the air. The eruption was rapid; it occurred in only two identifiable stages, with almost no pause in between. Because the vent was under water, steam explosions contributed to the violence of the eruption, and the rapid cooling of magma to tephra by the lake waters created very small particles, which the wind carried long distances. The magnitude of the eruption can be envisioned from the three-foot-deep ashfall at Chalchuapa, forty-five miles northwest of the source. Eruptions can also be compared by calculating the total volume of material blasted into the air. Geologists estimate that more than a cubic mile of ash was released by the big May 18 eruption of Mount St. Helens. By comparison, Ilopango may have blasted more than ten cubic miles of ash into the air, making this eruption one of the world's biggest during the past few thousand years.

The zone nearest Ilopango was one of complete devastation, where plants, animals, and, of course, people could not have survived. This was where ash fell to a depth of 6 to 8 feet—and up to 165 feet deep nearest the source. Although we cannot yet map its boundaries accurately, we can say that this zone was elongated to the northwest, extending at least eighteen miles on that side of the volcano, evidence that the eruption plume was pushed by the prevailing winds of the rainy season, which lasts from May to November. The absence of pollen in the tephra also confirms that the eruption occurred during the rainy season.

Beyond the zone of complete devastation was an area of more than a thousand square miles where most people would have survived, but where fields would have been too deeply buried by the white volcanic ash to be cultivable. If it is even a few inches deep, fresh, unweathered volcanic ash suffocates plants by interfering with transpiration, and adsorbed elements on the grains create acids when mixed with moisture. Windblown ash sandblasts plants and can topple or bury maize and other crops in a few days. In addition, Ilopango erupted at the worst possible time for the Maya farmers—during the rainy season when their crops were growing and food stores were low. They probably also had little stored water that could be used in such an emergency. Within days or weeks, thousands of people must have emigrated.

There are some archeological indications that the refugees moved north, to the Maya lowlands. Gordon Willey and his associates from Harvard University excavated the site called Barton Ramie in Belize and found that at the same time that a series of "foreign" artifacts showed up at the site, its population doubled. The intrusive artifacts stylistically match those that had been developed in El Salvador and were in use there just prior to the eruption of Ilopango. Illopango refugees also apparently settled at a number of other sites in the lowlands of northern Guatemala and Belize. For reasons we do not yet understand, however, there are also many sites in the lowlands that suffered a population decline about the third or fourth century A.D.

The eruption forced many people to evacuate their agricultural lands, but in outlying areas, where no more than one or two inches of tephra were deposited, people could have adjusted to the changed conditions. The tephra would have caused problems for a few years, especially for farmers nearest the



Above: The area dominated by the Maya culture encompassed both volcanic highlands and lowland terrain to the north. In about A.D. 260, the catastrophic eruption of Ilopango, a volcano located in what is now El Salvador, forced the Maya living in surrounding areas to abandon their farmlands for up to two centuries. Their major trade route, which led through Olmec territory into central Mexico, was rerouted to the north. These events may help to explain why Classic Maya civilization (A.D. 300–900) is associated with the lowland areas.

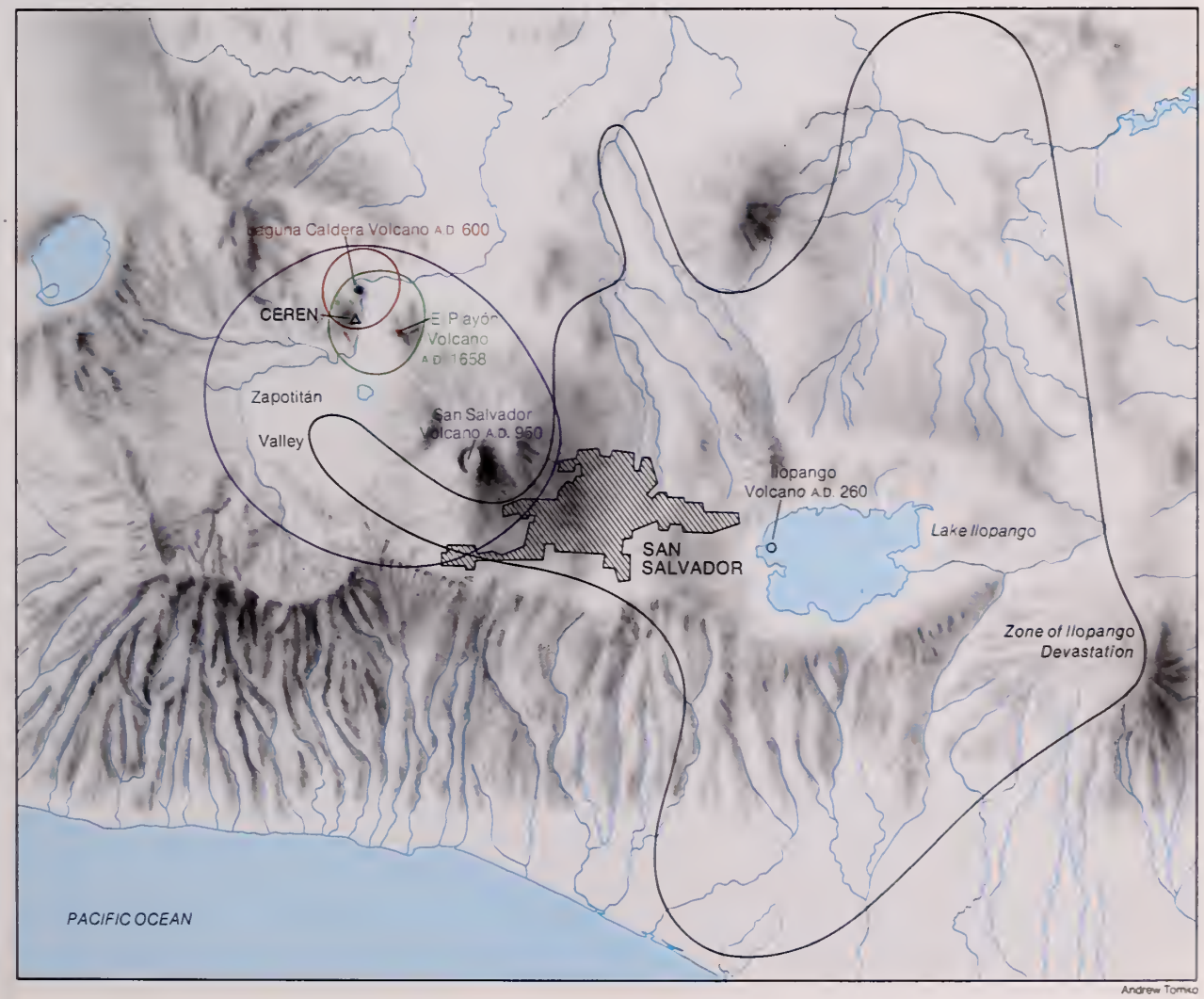
Right: The eruption of Ilopango created a zone of devastation (gray line) and blanketed adjacent areas with ash. These lands were eventually resettled, but in A.D. 600 the Zapotitán Valley was hit by the eruption of another volcano, Laguna Caldera, which buried Cerén and other sites in ash (orange line). Two other local volcanoes erupted later in the valley's history, depositing ash in about 950 (purple line) and 1658 (green line).

source, but before long, as the thin ash deposit became mixed with the soil, the favorable effects of the ashfall would have been felt.

Ilopango tephra may have actually reached as far as the Maya lowlands, where the Classic period of Maya civilization flowered from A.D. 300 to 900. Recent cores from northern Guatemalan lakes, taken by Edward Deevey and others of the University of Florida, show a drastic increase in silica in the Early Classic period. Silica is the dominant material of the Ilopango ash. If chemical tests confirm Ilopango was the source of the lake-core silica, we would still have to know the depth of the ash deposit in order to tell whether the lowlands suffered any initial detrimental effects. As the tephra weathered and was incorporated into lowland soils, however, it certainly would have been beneficial.

We may speculate that Ilopango actually played a role in the emergence of Classic Maya civilization in the lowlands. In addition to possibly receiving a thin deposit of ash, the lowlands would have been affected by the arrival of thousands of immigrants. A more intensive agricultural system would have been needed to feed the enlarged population, and a more complex political and social system would have been required to organize and control it. While I am convinced that Classic Maya civilization would have emerged in any case, the process may well have been accelerated. We can even point to at least one lowland site, Tikal, that profited directly from the disaster in the southeastern Maya area. Strategically located midway between the headwaters of two river systems to the east and west, Tikal appears to have seized control of the eastern end of the major Mesoamerican trade route, which extended as far as the basin of Mexico, site of present-day Mexico City. With the old route in shambles after the eruption of Ilopango, trade was rerouted to the north, contributing to the burst of prosperity so noticeable in Early Classic Tikal.

Had it not been for Ilopango, Classic Maya civilization might have flowered first in El Salvador and adjacent southern Guatemala, instead of in the lowlands to the north. Because of the thick blanket of ash covering the countryside, however, people abandoned central and western El Salvador, along with adjoining areas of Guatemala and Honduras, for at least a few decades, and in the worst hit areas, for about two centuries. Composed predominantly of silica, the ash from Ilopango was an "acid" tephra. It provided few of the nutrients needed for plant growth and weathered relatively slowly. We will not know the details of vegetative succession in El Salvador until we have taken lake cores and analyzed the pollen, diatoms, and other sedimentary materials they contain. In general



terms, the process of soil recovery would have begun as the rains leached out adsorbed acids. The first plant recolonization was probably by lichens, followed by grasses and ferns, and finally, by bushes and trees.

Evidence of human resettlement in El Salvador is dramatically preserved at Cerén, a Pompeii-like site that I began excavating in 1978 as part of a multidisciplinary research team. Cerén lies in the Zapotitán Valley, some twenty-five miles northwest of Ilopango. People deserted the valley when Ilopango buried it in about six feet of ash. Ironically, about A.D. 600, only a short while after the area was finally resettled, a local volcanic eruption buried part of the valley once again, freezing the landscape and society in time.

Laguna Caldera, the volcano that buried Cerén the second time, is less than a mile north of the site. In contrast with Ilopango, its eruption in 600 covered only a small area—about eight square miles—with a deep layer of volcanic ash. The long-term cultural effects of Laguna Caldera's eruption were therefore negligible in contrast to the Ilopango eruption, but the event was a boon to those of us who seek to reconstruct past ways of life. This is because the layers of tephra that Laguna Caldera deposited across the local countryside had excellent preservative characteristics. First, a fine-grained tephra fell with moisture in it, packing around the leaves of growing corn plants, around the leaves and trunks of trees, and around grasses and other plants. What is left is a cast of the vegetation, and preservation is so detailed that even cellular structures in the corn plants can be observed under a microscope. The fine-grained layer, some six inches thick, was closely followed by a thinner, hot deposit of cinders and lava bombs. Richard Hoblitt of the U.S. Geological Survey in Denver has determined, by a complicated analytic technique involving remnant magnetism, that the hot layer fell at a temperature over 1,000°F, which had the effect of baking much of the buried vegetal materials, carbonizing and thus preserving them. Within a few months, additional layers of tephra accumulated, so that the total depth of ash at Cerén is between twelve and twenty feet.

Our excavation at Cerén shows that



about two hundred years after the eruption of Ilopango, people began to recolonize the Zapotitán Valley and to farm its partly recovered soils. The land had a neutral pH and was fairly rich in nitrogen, but it was very weak in phosphorus, magnesium, manganese, calcium, and potassium. And, if that were not enough, the earliest settlers damaged the soil by forest clearance, which allowed the rains to carry away substantial amounts of the topsoil. The slightly sloping cornfield we have excavated shows that the Maya farmers attempted to counteract the erosion with low, crisscrossing ridges of soil. These ridges helped to force rainwater to puddle instead of run off, maximizing infiltration of moisture into the porous soil.

Then, about the year 600, only fifty or seventy-five years after the Zapotitán Valley was resettled, nearby Laguna Caldera erupted. The Cerén cornfield was buried in twelve to eighteen feet of ash with much deeper accumulations toward the source. The corn, planted at the tops of the ridges, was only four to six inches tall. Because the cornfield was not irrigated, we know that the eruption struck early in the rainy season—in late May or early June.

Laguna Caldera not only buried and preserved agricultural fields and natural vegetation, it also preserved the houses of a village. Based on the information available at present, houses were spaced about 165 feet apart, with their agricultural fields in between. On the average, that allowed each household only about five-eighths of an acre. This would not have been sufficient to feed a family, especially since low soil fertility did not permit a high density of maize plants—only about 12,000 per acre, compared to 20,000 to 24,000 per acre in present-day fields in the highlands to the northwest. The Cerén farmers were probably farming addi-

The acropolis of Tikal represented Maya civilization at its height. Located in the lowlands of Guatemala, the city prospered after the eruption of Ilopango, when the main Maya trade route was diverted to the north.



John Keshishian

John Keshishian



The volcanic axis of Central America includes Pacaya, a volcano located near Guatemala City. In the 1960s, ash from Pacaya's relatively small eruptions was deposited as far away as Tikal, in the lowlands.

tional plots outside the village, perhaps using the slash-and-burn technique to clear land on the hillslopes nearby. Future research is planned to look for and document such extensive agriculture outside the village.

A farmhouse we excavated in 1978 was constructed by mounding and smoothing a clay platform, which was then fired as one large brick by building fires all over it. Columns and walls of clay were constructed next and a roof of palm thatch added. The columns are enigmatic, as the roof was supported, not by them, but by vertical poles coming out of the walls. I should point out we did not excavate the entire house because its northern portion had been bulldozed in 1976, when the Salvadoran government was constructing a grain-storage silo complex. Local people who observed the bulldozing reported seeing a number of bodies on the floor of the house, clustered around a few polychrome pottery vessels. If this description is accurate, it could be that the Maya residents gathered around their ritual pottery for a final ceremony to try to save themselves from the eruption of Laguna Caldera.

There were various activity areas within the farmhouse. In the pantry, we found four large pottery storage jars—crushed by the tephra overburden—and a grooved stone maul. Two of the vessels were empty when we found them; they may have been empty that spring day or they may have contained liquid that did not preserve. The other two vessels contained small beans, *frijoles de arroz,* which are still cultivated in the highlands today.

One room contained a pottery-making area. On the floor was a lump of prepared potter's clay, a lump of hematite (red iron oxide used for paint), and an andesite flake that was used as a pottery smoother. The family in this farmhouse had polychrome vessels and apparently were making their own. They were also receiving some polychrome vessels from traders, brought from as far away as Copán, Honduras (70 miles to the north), and perhaps even from Costa Rica (360 miles southeast). These findings at a humble farmhouse require reevaluation of the idea—subscribed to by many archeologists who study the Maya—that fancy polychrome pottery is an indicator of high status.

About thirteen feet west of the farmhouse we found an outbuilding constructed much the same way as the house, with a fired-clay floor and a palm-thatch roof, but without wattle and daub walls or interior partitions. The scatter of obsidian debris south of this structure indicates that it served as an area for manufacturing stone tools. Early Spanish accounts of the Maya identify this as a male activity, while the areas we found in the main farm-

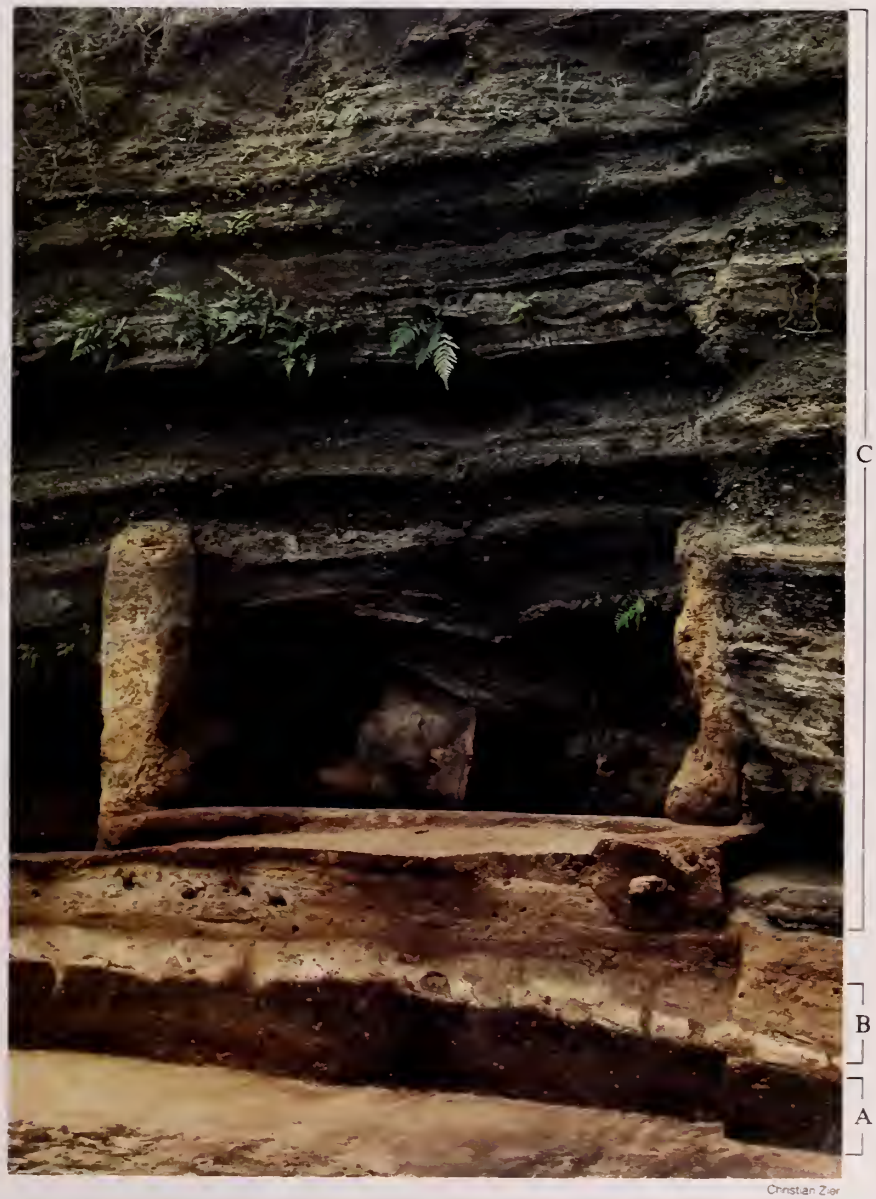
house are all associated with female activities.

The use of both clay and obsidian by the farmers at Cerén reminds us that in addition to fertile soil there are other important resources created through volcanic activity. The local clays, which the Maya used not only for pottery and houses but also to build their pyramids, is formed from weathered deposits of volcanic ash. Obsidian, the most valued material for toolmaking, is, of course, volcanic glass. Hematite, the red iron oxide these people used as a pigment, is also a volcanic product.

After excavating the cornfield, farmhouse, and outbuilding, we naturally wanted to know if there were other, similar buried and preserved houses and fields. We learned from local informants that one such structure, about 200 feet northeast of our farmhouse, was completely destroyed during the 1976 bulldozing. But how could we detect buildings under twelve to eighteen feet of volcanic ash? With a mixture of hope and desperation, I turned to geophysics. In June 1979, with geologist Hartmut Spetzler, I tried three portable instrument systems in the large field south and west of our farmhouse: a seismograph, a resistivity device to measure the passage of the electricity through the ground, and ground-penetrating radar. Each was used to try to detect buried structures as geophysical "anomalies." Within the 300-by-300-foot grid we set up, we detected a few anomalies to which the resistivity and the radar systems were particularly sensitive. With the geophysical instruments alone, however, there was no way for us to determine whether these anomalies were natural ones caused by unusual deposits or conditions of erosion or (as we hoped) "cultural" ones caused by prehistoric Maya structures.

In January 1980, I returned to El Salvador with colleagues from the University of Colorado to determine the nature of the three anomalies. We used a core-drilling rig borrowed from the geologic department of the Salvadoran government. The first anomaly cored turned out to be cultural, for the rig pulled up flooring at a depth of fourteen feet. The second anomaly drilled also turned out to be a structure, this time buried by twenty feet of tephra. (This second anomaly had an air cavity just above the floor, something we won't be able to explain until it has been excavated.) The third anomaly remains enigmatic as no unusual cultural or natural feature was detected. We have pretty much worked out the technological details of locating buried structures; all we are awaiting now is the end of the civil war that is racking the country, so that we can return to excavate more buried houses and their fields.

Given our knowledge of Maya settlement patterns, we are virtually certain that a small city or large town also lies entombed somewhere under the Laguna Caldera tephra, whose maximum depths have yet to be probed. Such a site should have a pyramid-plaza complex at its center, with palaces and possibly a marketplace and areas for craft specialists. The excavation of such a site would add immeasurably to our



Christian Zier

The excavation of a sixth-century Maya farmhouse at Cerén, in El Salvador's Zapotitán Valley, reveals a stratigraphic record of volcanic activity. The eruption of Ilopango in about A.D. 260 buried fertile brown soil (A) under a layer of white volcanic ash (B). After the valley was resettled, a house was built with a fired-clay floor and clay columns. This structure was destroyed by the eruption of nearby Laguna Caldera in about A.D. 600. Prehistoric remains were unusually well preserved under the thick deposit of ash from that volcano (C). Later eruptions, of San Salvador volcano in about 950 and El Playón volcano in 1658, added thinner layers of ash on top.

knowledge of the Classic Maya, given the sudden and detailed preservation caused by the eruption of Laguna Caldera. Most archeological excavations are of places that have been abandoned—often gradually—by the original inhabitants. At Cerén and associated sites, however, we should be able to find, in place, the full inventory of tools and other cultural artifacts that will show us a society frozen in time.

In the Zapotitán Valley, we have a rare opportunity to explore four main aspects of Classic Maya prehistory. First, we will be able to learn about the climate and the natural vegetation, what plants were available, and how they were used. (The preservation of botanical and other organic materials in this area is remarkable, especially for the tropics.) Second, we will be able to study the crops that were cultivated and to learn the extent to which the Maya relied on seed crops (beans and corn) as opposed to root and tree crops. We will also be able to estimate the quantity and quality of these nutritional resources and their implications for population growth. Third, we will be able to study the composition of the family or household units that made up Maya society. To what degree were the farmers self-sufficient, and to what extent did they have to raise surplus food to trade for outside commodities and to support large political or religious institutions? Finally, assuming we do locate a town or small city, we hope to learn who were the elite members of the society, what their official functions were, and how they lived. What expensive items did they enjoy as luxuries or store for redistribution to other sectors of the society? If Laguna Caldera erupted in the daytime, we may also find the remains of a fully assembled marketplace, which would provide a record of the specialty items produced locally or traded from afar. In brief, when our work can be resumed, we will examine every level of the society as it operated in 600.

Although the record of Maya civilization concealed under the Laguna Caldera tephra is particularly intriguing to archeologists, that layer of ash does not mark the end of volcanism and human settlement in the Zapotitán Valley. It was not long before people reoccupied the area struck by Laguna Caldera, perhaps within ten to twenty years on the periphery. The next volcanic eruption to leave measurable amounts of ash across the valley was that of San Salvador volcano (Boquerón), some time about 900 or 1000. The volcano, located on the southeastern border of the valley, deposited a white, pasty, sticky layer of tephra over an area of about 120 square miles. The accumulation was heaviest on the western side of the valley, no doubt discouraging agriculture, but the disruption was not serious. In 1658—in historical times—there was another significant eruption, this time of Playón volcano, near Cerén. Up to three feet of ash was deposited over some thirty square miles, and lava flowed over five square miles, burying a town and a number of farms. Since then, volcanic activity has been minor, although by no means absent.

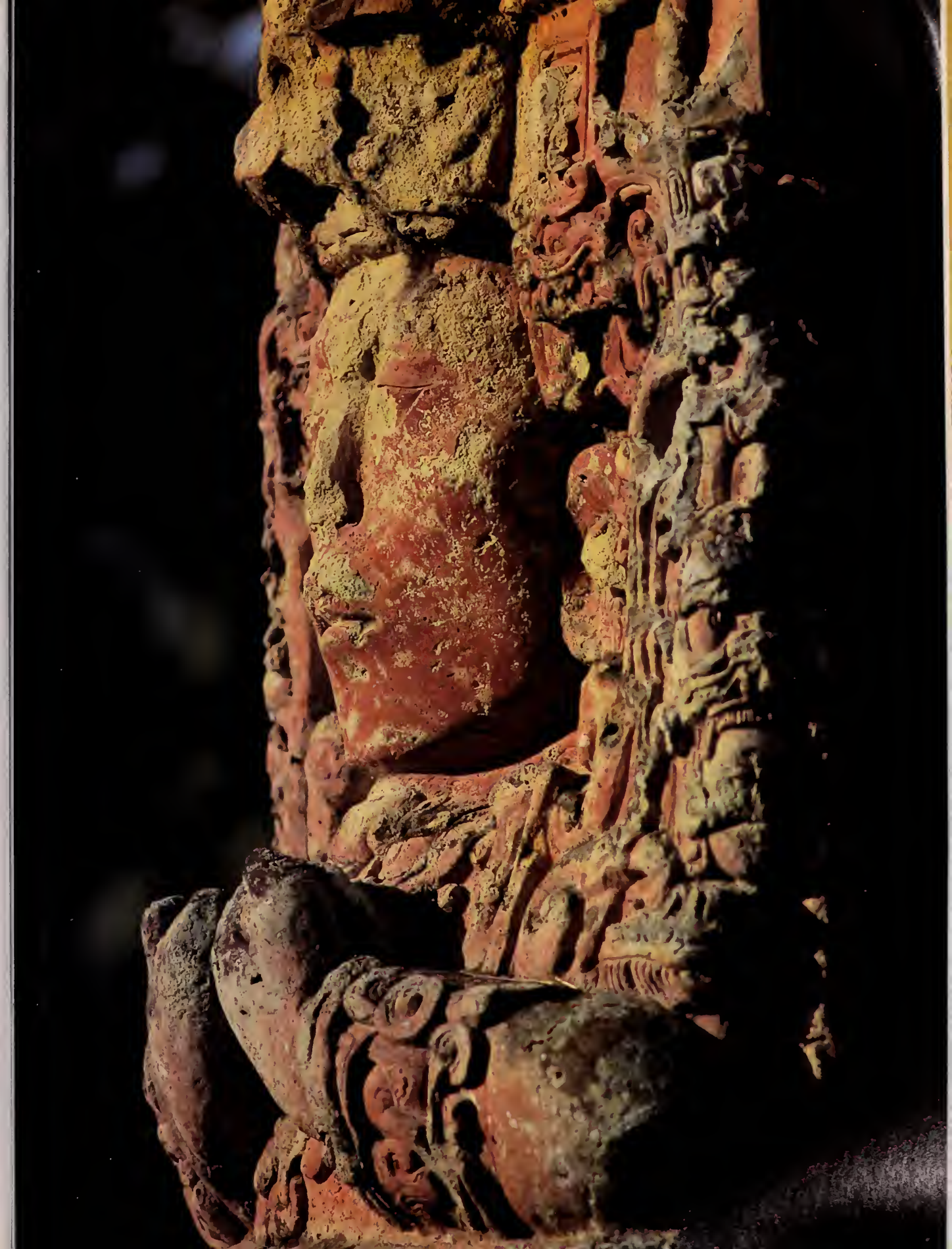
Today, people continue to occupy this hazardous region, just as people in San Francisco continue to live and work near the San Andreas fault. As far as they are concerned, the short-term benefits outweigh the risk of disaster. In a volcanic area, however, it is not a question of whether a new disaster will strike, only a question of where and when. In El Salvador, the next major eruption could occur at any time. □



Lee Boltin

The ceramic stand for burning incense, left, would have once graced a pyramid in the western Maya lowlands of Mexico. The stele, right, depicts a ruler of Copán, a city in Honduras. Both objects are from the Late Classic period of Maya civilization.

David Alan Harvey





Sleight of Wing

Avocets and stilts employ a dazzling repertoire of distraction displays to deceive potential predators. Even ornithologists have been fooled

by Tex A. Sordahl



Among the most striking features of animals are those concerned with predation, a point not lost on early naturalists, who were greatly impressed with "fang-and-claw" biology. Birds of prey tearing away at their victims with powerful, piercing talons and bloody, hooked beaks were common images in avian lore. This emphasis on the weapons of such raptors as eagles and falcons, while overblown, was perhaps understandable. The defensive strategies that have evolved among some of the prey, however, are at least as fascinating to the careful observer as the attack of a predator. Consider the American avocet, with a bill shaped like a shoemaker's awl (hence the colloquial name awlbill), and the black-necked stilt, whose wading apparatus has earned it the name longshanks. While such features aid the birds in preying on aquatic invertebrates, it seems ironic that they limit the birds' ability to deal with their own predators. Slender, sensitive bills, adapted for detecting by touch small prey in muddy water, have little utility as weapons; the same is true of long, slender legs.

If avocets and stilts cannot produce a strong offense as a defense, neither can they find hiding places or refuges from predators on the open ponds and shorelines they frequent. Black-and-white plumage poised atop long, grayish blue or red legs makes both avocets and stilts prominent features of their open habitats. The attributes that gave rise to the old vernacular names for American avocets—Irish snipe, white curlew, blue-stocking—make them anything but inconspicuous.

Early American hunters ranked avo-

The slender legs and upturned bill of an American avocet are poor weapons with which to repel predators. When its eggs or chicks are in danger, however, the avocet performs a series of displays to befuddle a predator.

Tom Bledsoe

cets and stilts as decidedly second-class table birds, but did find them palatable, as do hawks, owls, and foxes. Essentially the only protection avocets and stilts have is that of being alert and fleeing from predators. Living in flocks reduces the chance of being ambushed because there are more pairs of watchful eyes. In fact, fleeing from predators works reasonably well for the birds during most of the year. But it cannot work, of course, for a chick that is unable to fly. Although parent stilts and avocets can protect themselves by fleeing, their young are usually best protected if the adults remain to interact with the predator. Interactions with predators necessarily carry an element of danger—and there hangs a tale.

Worldwide, there are up to six stilt species and four avocet species (opinions vary on how many should be recognized); all are close counterparts of the North American duo. With avocet and stilt representatives on every continent except Antarctica, this chiefly tropical- and temperate-latitude family is obviously successful in its bipartite wading-bird niche. Although none are found in polar regions, one of the avocets lives in the Andes at elevations above 9,500 feet.

Despite their widespread conspicuousness, stilt and avocet biology is poorly known. To date there have been only two scientific investigations of American avocets and one of black-necked stilts, supplemented by a few published accounts of brief studies and some recent research on an endangered subspecies, the Hawaiian stilt.

With this in mind, I set out to study the breeding behavior and ecology of avocets and stilts in northern Utah. Working at the Bear River Migratory Bird Refuge and at a private duck club known appropriately as the Barrens, I observed avocets and stilts for six years, with two and a half of those years spent in intensive study. I quickly discovered that field conditions at the Barrens are suboptimal for people. Amid snow, ice, and bitter winds, avocets arrive in mid or late March, and stilts about two weeks later. Twice a week snowstorms usually cease by the end of May, when ameliorating temperatures bring a surge of mosquitoes, black flies, horse flies, and deer flies. Summer temperatures soar to 120°F on the shadeless salt flats and not only made life unpleasant for me and the birds but also threatened the lives of the embryos encased in insolated eggshells (eggshells that are exposed to the sun).

I was particularly intrigued by the behavior avocets and stilts use to protect their eggs and chicks against predators. Eggs are usually laid in the open or in the short desert salt grass found in and around marshes (stilts have a greater tendency to nest in the grass than avocets do). Sometimes the nests are conspicuous mounds elevated above floodwaters. Regardless of nest-site details, the situation seems potentially hazardous. With a large, brightly plumaged bird sitting on three or four tasty eggs in an exceptionally open environment, a nest predator has only to spot the conspicuous adult, chase it away, and consume the eggs. So avocets and stilts, necks erect like periscopes, watch carefully as they incubate, and at the first sign of a potential predator, they slip away, making it difficult for a predator to find the cryptic eggs. But during adverse weather—snow, rain, or sizzling heat—eggs can be killed by fairly brief exposure. And during moderate weather the embryos will not develop at normal rates unless heat is applied by their parents. Inattentiveness, then, could result in a prolonged incubation period, and thereby extend the period of susceptibility to predators. Thus avocets and stilts can ill afford to be away from their nests for long periods while predators slowly search the marsh. Lacking both offensive and defensive potency, avocets and stilts have nevertheless evolved remarkable forms of behavior that cause predators to move on quickly or at least look in the wrong places for nests and chicks.

In terms of direct actions that tend to



Robert Lee, Photo Researchers

achieve these results, avocets and stilts may be the versatility champions of the bird world. I doubt that any other bird possesses such a large repertoire of antipredator displays. Distraction displays, which attract attention to the adult rather than to its nest, range from a series of wing displays, in which one or both wings are extended or waved, to false incubation displays in which the bird squats on the ground as though sitting on a nest. (Such false incubation displays are sometimes performed on seemingly inappropriate substrates, as when birds would apparently have a predator believe they are incubating in the water.) Displays may be given in rapid sequences or simultaneously, so that stilts look like whirling dervishes (avocets, being much slower, look more like drunken dervishes). Through it all the birds are continually vocal—stilts yapping raucously, and avocets piping insistently or giving pitiful-sounding "wounded bird" calls.

Standing tall over its nest in the Bear River Migratory Bird Refuge in Utah, an American avocet, left, peers intently at the photographer. Humans and other potential troublemakers rarely get close to the nest, with its cryptically colored eggs and chicks, below. The parent bird usually intercepts would-be trespassers of its nesting territory and attempts either to lead them astray with a distraction display or to repel them with dive-bombing tactics.



Tom Bledsoe

Distraction displays of avocets and stilts differ in details, but the basic form is essentially the same. Differences are mostly attributable to the ecological exigencies that have produced two different body plans within this shorebird family. Although avocets and stilts sometimes look similar in size when seen in the marsh, avocets are in fact nearly twice as heavy; the stilt, however, whose delicate appearance belies its rowdy disposition, has wings as long as, and legs considerably longer than, the avocet's. The net result is a heavy, slow, relatively powerful avocet and a skinny, hyperactive, agile stilt.

Avocet and stilt distraction displays are unusual in that they only sometimes look as much like "injury-feigning" as the displays of other bird species. It is widely held that, on encountering prey, predators evaluate their chances for success and that criteria of special importance to them are abnormal movement and appearance—attributes that often signal injury or sickness and hence easy prey. The implication is that this characteristic of predators accounts for the origin of distraction displays. And there is no disputing the abnormal appearance of a stilt or an avocet performing a distraction display.

Brief observations of avocet and stilt behavior can be misleading. Underestimating the birds' sharp eyesight, early naturalists believed their presence was undetected and misinterpreted distraction behavior as courtship. (Pair formation is actually a subtle and drawn-out affair lasting days or weeks, while copulation is associated with a set of highly ritualized behaviors lasting from forty-five seconds to a maximum of three minutes.) The following account by one early observer of black-necked stilt "courtship" serves as a colorful description of distraction:

> Although my approach was not especially careful, the two pairs of stilts . . . seemed unaware of my presence as I sat on a tussock of grass at the edge of the pool. . . . The four birds were close together . . . in the shallow water, bowing, fluttering wings and frequently half leaping–half flying . . . into the air. After a few moments . . . one bird . . . executed a flying leap . . . and . . . kicked up a shower of spray, using the feet . . . quite suddenly . . . all four birds flew steeply upward to a considerable height where they remained for some time flying . . . in wide circles, giving utterance to their loud, sharp call. Gradually . . . the four birds spiralled downward to alight in the shallow water and begin anew the . . . ritual of bow, flutter, leap, spray. This sequence was repeated again and again during the hour and a half I sat upon the grassy tussock.

No less an authority than Arthur Cleveland Bent was taken in by the same behavior. After two brief visits to avocet breeding grounds in Saskatchewan, he wrote in 1907:

> While conducting their courtships, in May, the avocets were always amusing and often grotesque in their movements, as they danced along the shore or waded in the shallow water holding their wings fully extended, tipping from side to side, as if balancing themselves. Sometimes they would run rapidly along crouching close to the ground, frequently nodding or bowing and sometimes they would lie flat on the water or ground, with wings outstretched as if in agony. At such times they were very tame, apparently oblivious of all else, and could be easily approached.

From the birds' point of view it made no difference that their behavior was misconstrued. It accomplished its purpose—neither observer could find any nests.

Still looking for a type of courtship that is nonexistent among these birds, Bent later wrote in his *Life Histories of North American Shorebirds:* "frequently they fooled us by squatting down on the ground, as if sitting on a nest; if we went to investigate, they would run away and repeat the act elsewhere; perhaps this act carried the suggestion of mating as a part of the courtship ceremony."

The most spectacular stilt and avocet antipredator behavior is formally called the dive bomb. As is evident from the name, the birds mob their predators, swooping at them, but narrowly missing them. The avocets and stilts present quite a spectacle pursuing a great blue heron or a black-crowned night heron so hotly that it crawks, harrying a California gull until it screams wildly, or worrying a short-eared owl into drastic evasive maneuvers. Because avocets and stilts defend a 300- to 600-foot-radius around their nests and because nests are usually aggregated into semicolonies with nests no more than about 150 feet apart, the intruding predator often finds a good deal more than one pair of parents zeroing in on it. During intense mobbing a single bird generally makes a swoop every ten seconds, and I have recorded stilts swooping as frequently as every seven seconds. A mob-



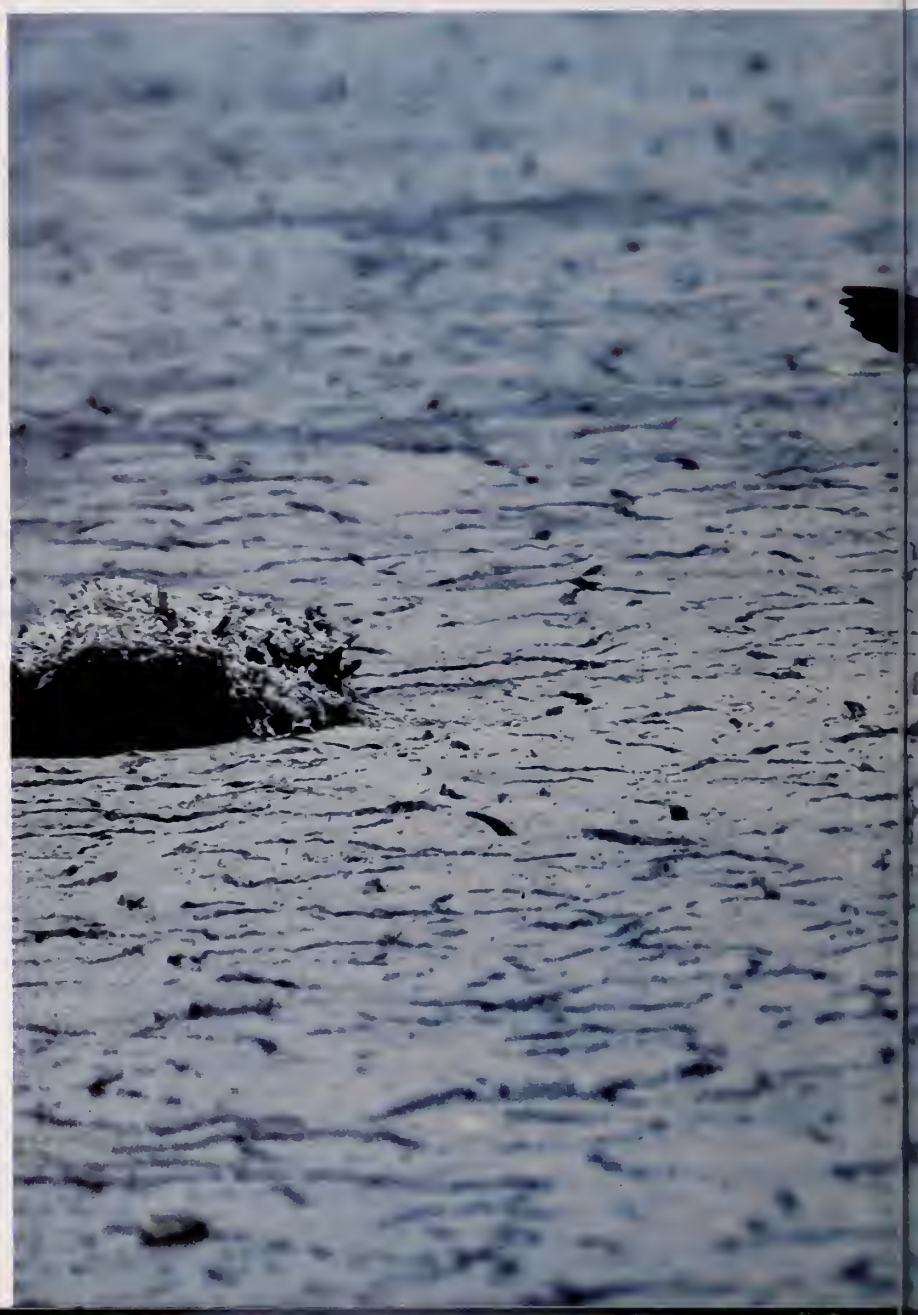
Jim Brandenburg

group may make a swoop per second. For the predator, this must be like facing an aroused beehive. Most predators withdraw rather quickly, but if not, mobbing may continue for more than an hour. An osprey, under attack by six avocets, made the most hurried retreat I have seen.

This vicious-looking behavior is almost entirely bluff. As mentioned previously, avocets and stilts lack offensive weapons and beneath the veneer of breeding-season bluster are remarkably gentle animals. Their relatively soft, flexible bills culminate in a tiny fragile hook on the upper mandible, most pronounced in avocets, that probably keeps slippery prey from slipping away. Overall, these bills are most unsuitable structures for striking a blow. Indeed, hundreds of avocets and stilts that I



Tom Bledsoe



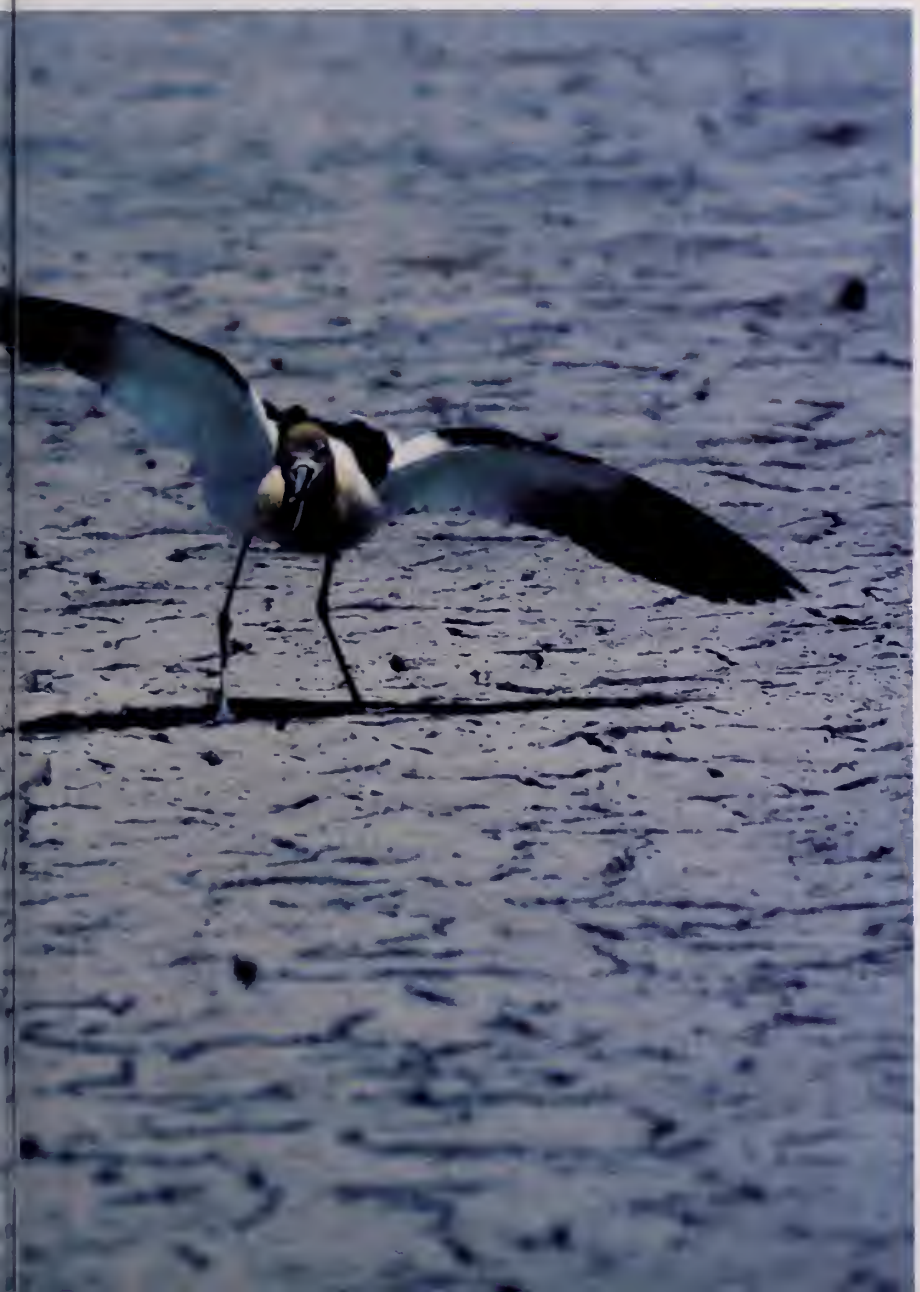
Reacting to perceived danger, an American avocet, top, is attempting to lure the source of the threat away from its nest. The birds commonly take to the water as part of their repertoire of distraction maneuvers. Somewhat more dramatically, another avocet, right, appears to feign injury. The idea, apparently, is that predators will zero-in on abnormally behaving prey, as they often represent an easy meal. Similarly, the black-necked stilt, leaping into the air, above, is engaged in distracting a possible predator. Early naturalists, observing such odd behavior, presumed they were witnessing courtship displays.

Charles G. Summers, Amwest

have banded seemed reluctant to have their bills touched, and they certainly never pecked at me.

Most predators of stilts and avocets are not only larger than their prey but also possess specialized weapons. There is little chance for a stilt or avocet to injure a predator without suffering worse consequences itself. Physical contact with a predator is extremely rare, but as avocets and stilts swoop by, they sometimes attempt to kick predators that are on the ground. It must be uncommon for these kicks to come in contact with a live (and thus mobile) predator, but stuffed hawks, crows, and gulls that I set out were kicked so hard that they fell over. (After kicking more firmly anchored predator models, stilts sometimes shook their legs, as though they were sore.) Even without contact, water and mud flying from kicking legs must be annoying to a predator.

But why should a predator be repulsed by such sham attacks? Why does it not learn that it will not be injured? It should be admitted at the outset that avocet and stilt mobbing is not as effective as that of species capable of inflicting injuries on the predator; the hard-hitting terns, for example, seem to inspire more respect in their nest predators. But, as anyone who has experienced mobbing can attest, it is difficult not to flinch in the face of a dive bomb; it would be even more difficult for a predator that had previously been struck by a mobbing tern or even by a red-winged blackbird. If the predator has not yet seen or captured the eggs or chicks, it may be very difficult for it to concentrate on searching in the midst of a storm of harassment by the parents. Consequently, it may often be to the predator's advantage to move on quickly. But there may be something more subtle involved. There is always a slight chance that the avocet or stilt may strike the predator, even if by accident. Such a high-speed collision would probably cause as much damage to the mobber as to the predator. The avocets and stilts should theoretically be more willing to take this risk, however, because they are playing for higher stakes—failure for the mobber results in the loss of part or all of a season's breeding effort and possibly its own life, whereas failure for the predator results in the loss of one meal. Thus, in many contest situations, it is the avocet or stilt that exhibits "valor" and the predator that shows "discretion."



There are many records of predators turning on their mobbers and killing them. This ever present danger, along with the need to avoid unnecessary absences from the nest (responses to false alarms), should be a powerful selective force for the ability to recognize which animals are predators and which predators are the most dangerous. I found that avocets and stilts are indeed sophisticated in their discrimination of predators. I have seen them mob at least fifteen bird and four mammal species. Mammals and birds are treated differently, and each avian predator evokes a different response, which seems to depend on how dangerous it is to chase. Moreover, avocets and stilts distinguish a diversity of nonpredators and do not chase chick predators during the egg stage or egg predators during the chick stage.

Seventeen years ago, Dutch ethologist Hans Kruuk pointed out that there are three basic types of predators that nesting birds must contend with: those (such as the peregrine falcon) that prey on the adults but not their eggs; those (such as the red fox) that prey on adults and their eggs and young; and those (such as the California gull) that prey only on eggs or chicks. A different antipredator strategy must be employed for each. While a gull can be mobbed with reckless abandon, a peregrine must be harassed cautiously if at all; a fox is difficult to deal with but can be distracted away from the nest or chicks. Through it all, the parent must not sacrifice its life for the brood, because then all would be lost—there is virtually no chance for the chicks to survive without protection, and no chance to rear another brood. The parent must tread the

line between too little defense and too much. Whether a parent mobs a particular predator depends on the danger to the adult if it does mob and the danger to the eggs or chicks if it does not.

In their long-term study of the ecology of peregrine and prairie falcons in Utah, Richard Porter and Clayton White found that American avocets were by far the major prey species brought to aeries. Undoubtedly, this was mostly due to their abundance in the marshes and their misfortune in being the ideal size for the falcons to carry back to the cliffs. Since neither of these large falcons hunted at the Barrens, I was curious about how avocets and stilts might react to them. So I enlisted the aid of a local falconer. On the two occasions he flew his prairie falcon at the Barrens, the bird, accustomed to hunting pheasants and pigeons but unaccustomed to the teeming bird life of a marsh, soared into the clouds and wasn't recovered until the next day. The project had to be discontinued. I wish I could boast that the avocets and stilts had driven the falcon away, but they seemed to ignore him. Current programs for restocking peregrines in Utah hold promise for answering questions about the behavior of breeding avocets and stilts toward them.

How avocets and stilts obtain the information about specific predators that allows them to employ their discriminatory powers, and on what basis they discriminate, is unknown. The fineness of discrimination and the large number of animals dealt with suggest that much of it is learned. For example, stilts in Utah ignore the mostly insectivorous Franklin's gull, while in Florida they vigorously mob the similar-looking but egg-robbing laughing gull. How do they learn that a golden eagle is too dangerous to dive bomb, but ravens or marsh hawks can be chased at less risk? Since the penalty for making a mistake may be injury, breeding failure, or death, it seems doubtful that trial-and-error learning is the principal means of gaining knowledge about predators. I am tempted to speculate that chicks learn by observing their parents and neighbors during the twenty-eight days or so before they are able to fly. They should be especially attentive to their parents' behavior then because their very lives depend on running or hiding at the first alarm. But acquiring knowledge about predators in this way would entail an outstanding memory. Volant birds without eggs or chicks react only to predators that prey on adults, and the response is to flee; hence, information about egg or chick predators would not be useful to avocets and stilts until they attempt to breed, probably at age two or older. It is perhaps more likely that young breeding birds learn about predators by observing more experienced neighbors in the colony, whose reactions to predators cover for some of the young birds' naïve mistakes.



Flapping its wings and running awkwardly, this black-necked stilt is demonstrating another variety of distraction display. Such defensive behavior is only partially successful, as 40 percent of all stilt and avocet eggs at one of the author's study sites were taken by predators.

Tom Bledsoe

About 40 percent of all avocet and stilt eggs at the Barrens were taken by predators, and another 8 percent of nests failed because an adult was killed by a predator while incubating. The main culprits seemed to be California gulls and red foxes, preying on eggs, and foxes and great horned owls, preying on adults. While the birds can renest if they lose a clutch early in the season, I suspect that the very large gull population may be swamping their defense system. The avocets and stilts cannot chase all the gulls and must return to their nests without having successfully driven them off. Both the American avocet and the black-necked stilt formerly nested along the East Coast as far north as New Jersey, but these eastern breeding populations were shot out in times of unrestricted gunning. Neither species has reoccupied this area, but a stilt population has survived in Florida. Currently, stilts appear to be expanding their breeding range north along the coast from Florida, a few nonbreeding avocets are summering regularly along the coast, and state wildlife agencies are attempting to reestablish a breeding population of avocets. But burgeoning gull populations in these areas could have a significant effect on the avocet and stilt recolonizing ventures. In the future the remarkable antipredator adaptations of avocets and stilts may be severely tested. □



The Whale Behind the Tusk

Myths and superstitions concerning the narwhal tooth have been a factor in the whale's exploitation

by Randall R. Reeves and Edward Mitchell

During the Middle Ages, European apothecaries frequently sold "unicorn horn," with the promise that it would cure epilepsy, strengthen the heart, induce perspiration, and buffer poison. The substance being offered was, in fact, derived from the ivory tooth of the narwhal, a small arctic whale. This species (*Monodon monoceros*) has only two fully developed teeth, both rooted in the upper jaw. In males the left tooth develops into a straight tusk protruding as much as seven or eight feet forward from the upper lip, its surface grooved in a left-handed spiral. Modern medicine has long since undermined the importance of "unicorn horn" as a pharmaceutical panacea, but the narwhal's remarkable tusk continues to stir the human imagination.

Most scientific explanations for the origin and function of the narwhal's tusk have not been tested by direct observation because the animal's high Arctic habitat makes study difficult and expensive. Casual observations by whalers and early naturalists gave rise to various speculations. Some argued that the tusk is used to poke breathing holes in ice; others that it is used to spear fish or at least to stir up bottom-dwelling prey. More recently, two dental anatomists speculated that the tusk operates as a cooling mechanism, allowing the well-insulated narwhal to dump excess body heat during spurts of physical activity. And acousticians have wondered whether the tusk might be useful in focusing or otherwise enhancing the echolocation signals by which the narwhal is believed to navigate and find food.

Helen Silverman, while a graduate student at McGill University in Montreal, spent three recent seasons on northern Baffin Island studying the social behavior of narwhals. She often saw the animals crossing tusks with one another, both above and below the water, an activity noted also by early Scottish whalers. Although little aggressiveness was evident during these episodes of tusk crossing, Silverman inferred that such behavior might help maintain dominance hierarchies and enable young narwhals to develop the skills necessary for performance of adult sexual roles. Unfortunately, her observations were limited to the summer season, June to October, and the narwhals' peak period of effective mating falls between March and May. As a result, whether narwhals actually use their tusks for more serious combat during the breeding season could only be inferred.

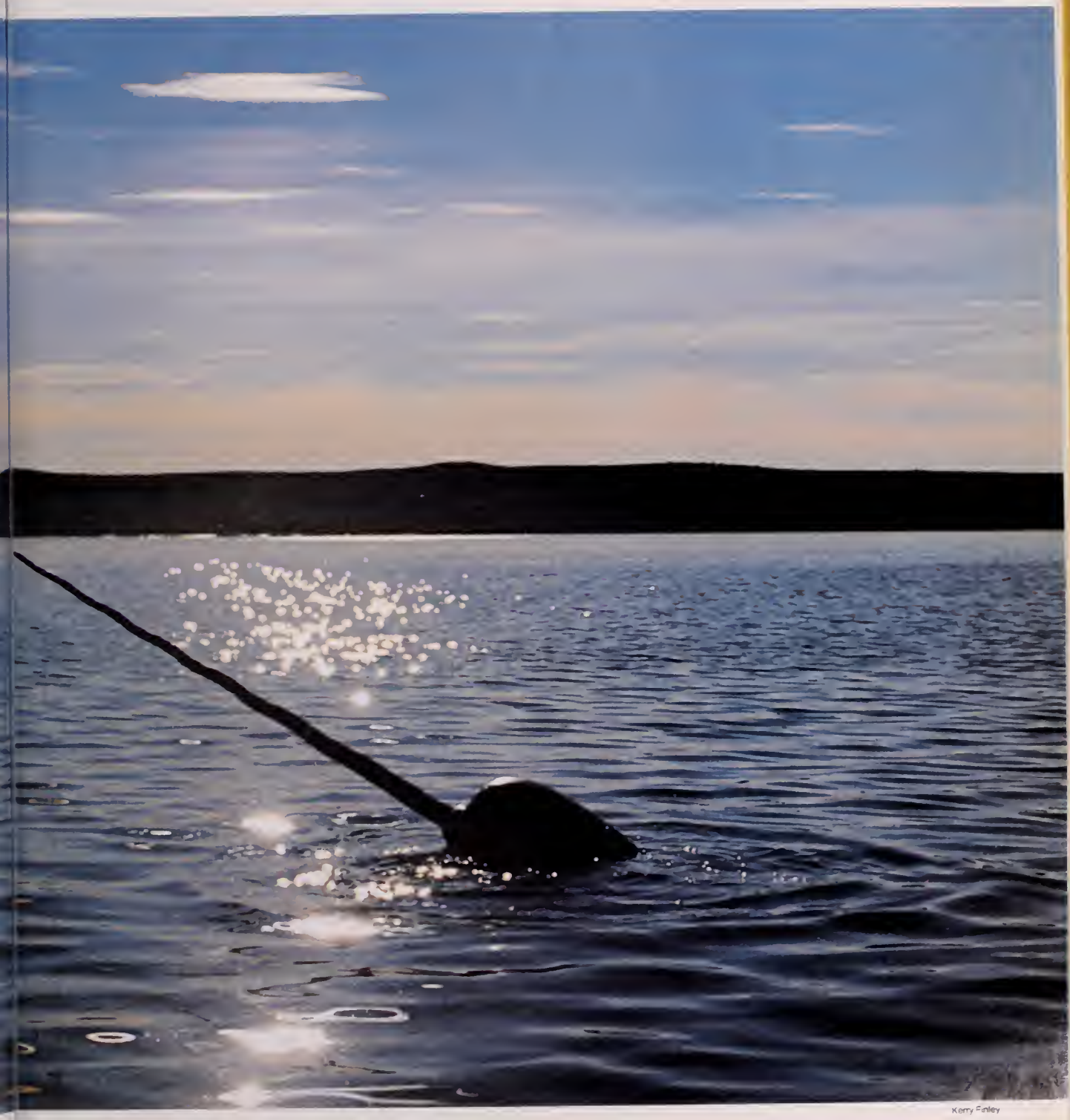
In addition to watching live narwhals, Silverman and others have examined animals killed by Eskimo hunters. A relatively high incidence of scarring is found on the heads of adult males, and more than half of them have broken tusks. One heavily scarred individual had a tusk tip embedded in the upper jaw near the base of its own tusk. This, together with reports of broken tusks into which the tip of another tusk has been jammed, is evidence that the tusk serves an aggressive function. A burst in growth of the tusk at sexual maturity has been taken as further proof of the importance of this appendage in agonistic confrontations between adult males.

Even if the evidence for its aggressive use begins to explain one function of the tusk, several interesting questions are left unresolved. For instance, of the male narwhal's two adult teeth, why does only the left one normally erupt through the gum, giving the animal an asymmetry rarely found in the natural world? Most other mammals with horns, tusks, or antlers have them in pairs (the one-horned Asian rhinoceros being an exception). Curved, paired tusks like those of the walrus, elephant, wart hog, and dugong are common in nature, but straight tusks, such as the lower jaw pair in the hippopotamus, are rare. The single, straight tusk of the narwhal is unique.

The narwhal's use of the tusk as a weapon need not rule out the possibility of other uses. In many large mammals bearing horns, antlers, and other cephalic appurtenances, these structures are important as signaling devices. If a



In male narwhals the left tooth develops into a tusk that protrudes as much as eight feet. Occasionally, in the calm waters of certain Arctic fiords, males may be seen with their tusks out of water.



Kerry Finley



Narwhals are most abundant in the Greenland Sea and in the Baffin Bay–Davis Strait area

Joe LeMonnier

well-endowed male actually had to fight every potential challenger, he would have little time or energy left for feeding or mating. The narwhal tusk may have a signaling function. If that is the case, then it is interesting to question whether the cues involved are visual, acoustic, tactile, or some combination of these. In any event, it seems likely that narwhal society is organized in such a way that prime bulls fight each other only after other means of demonstrating dominance have proved inconclusive.

The entire issue of tusk function may never be fully resolved. Although the tusk probably evolved for one or two primary functions, it could have been preadapted for a variety of other uses. For instance, does the tusk enhance locomotion in a manner similar to that of the rostrum of billfish? Could the warming of its boundary layer by the rapid conduction of heat from the tusk's pulp chamber into the environment reduce drag and improve the swimming efficiency of large males during critical episodes of physical exertion? Or might the polished tip of the tusk act as a lure, attracting phototropic prey?

Our own research has been concerned not so much with how the narwhal uses its tusk but with how *people* use it and, in the process, abuse its bearer. We have tried, in particular, to reconstruct the economic history of narwhal exploitation and determine what kind of impact commercial hunting has had on the stocks. Our quest has met with only partial success because ivory merchants have never been eager to divulge the details of their trade. Also, we still have only a vague idea of how many narwhals there are, how many there once were, and what natural factors control their abundance and distribution.

The particular date of the European discovery of the narwhal—or perhaps one should say the recognition of the creature for what it was—is difficult to pin down. Acknowledgment of the narwhal's existence, after all, would shatter the cherished myths and superstitions built around belief in the unicorn, to say nothing of what it would do to the profits of merchants trading on the alleged medicinal and restorative properties of unicorn horns. Suppliers of narwhal tusks were less than eager to see for themselves where the tusks actually came from, and when they could no longer hide the truth from themselves, they did what they could to hide it from prospective buyers. One story about the attempted sale of a tusk to a Russian prince, related by a seventeenth-century Danish savant, testifies to the merchants' lack of scruples:

> The Great Duke being extremely taken with the beauty thereof, he showed it to his physician, who understanding the matter, told him 'twas nothing but the tooth of a fish; so that this agent returned to Copenhagen without selling his commodity. After his return . . . he exclaimed against the physician



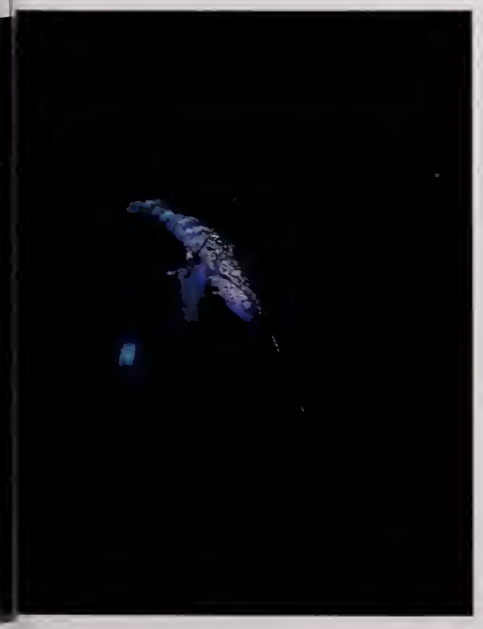
Fred Bruemmer

who spoiled his market by disgracing his commodities. "Thou art a half-headed fellow," replied one of the Directors of the Company, "Why didst thou not offer two or three hundred ducats to the physician, to persuade him that they were the horns of the unicorn?"

In studying the history of narwhal exploitation, we have focused on two fairly well-defined centers of the animal's abundance: the Greenland Sea and Baffin Bay–Davis Strait. The only major narwhal populations known are found in the vicinity of these deep, cold basins. No attempt has been made to assess the size or status of the Greenland Sea stock but it probably consists of several thousand narwhals. Stragglers will occasionally reach the British Isles and the south coast of Iceland. Small numbers, possibly from the Greenland Sea stock, are known to have appeared near the Russian islands of Novaya Zemlya and Franz Josef Land in the past. Recent reports from the Soviet Union, however, indicate that narwhals are now seen only infrequently in these waters.

The Baffin Bay–Davis Strait stock, which may consist of two or more separate populations, is larger and better known than the Greenland Sea stock. In summer, concentrations of narwhals are found in Lancaster Sound, Smith Sound, and northern Hudson Bay. Recent surveys suggest that the Lancaster Sound component may include more than 20,000 whales. Strays from the Baffin Bay–Davis Strait stock sometimes wander as far south as Newfoundland.

Outside of these areas, the narwhal's occurrence is sporadic. It appears only occasionally along the north coast of Alaska, and rarely ventures south of Bering Strait. Soviet scientists claim that a small population is present in the northern Chukchi Sea, but the basis for their statement is unclear.



Narwhals have been observed crossing tusks with one another both above and below water. Biologists speculate as to whether more serious combat takes place during the whales' breeding season.

Narwhals were probably hunted by Europeans for commercial purposes as early as the tenth century, soon after the Vikings began to establish permanent settlements in southwest Greenland. Norwegian merchants called regularly at the colonies, and ivory and skins were important export goods. Many of the colonists' seasonal hunting expeditions to the north were sponsored by the Norse Greenland Church, which took a special interest in the acquisition of walrus and narwhal ivory. In fact, settlers sometimes paid their Peter's pence, or tithe, in ivory.

We have not been very successful in documenting the volume of this early trade. In 1126, tusks "mark'd with Danish letters writ upon them with some glutinous matter, scarce to be effaced by the art of men," were found on an Icelandic beach near the Pool of Corpses, the site of a shipwreck. These runic letters were interpreted as the marks of individual sailors who were bringing the curious "whales' teeth" home from Greenland as souvenirs. Even if this was a common practice, however, it probably accounted for relatively few tusks. Another ship with a cargo of "unicorn horns" is said to have gone aground at Iceland in 1242. This first, poorly documented episode of commercial exploitation, which we suspect to have been modest in its impact on the narwhal population, probably ended during the late 1300s as commerce between Europe and the Viking colonies declined.

Aside from continued native hunting, the next phase apparently began early in the seventeenth century. British explorers in Davis Strait, most of them having read Martin Frobisher's description of a dead narwhal found floating at the mouth of Frobisher Bay in 1577, recognized the narwhal but seldom hunted it. The tusks they brought home had usually been obtained from native hunters in exchange for glass or iron trinkets and beads. Dutch traders were active along the West Greenland coast. The logbook of a Dutch schooner anchored in a Greenland fiord in 1652, as summarized by the Danish historian Finn Gad, states:

> Immediately the Eskimos sailed out to the ships with trout, seal skins, and "sealskin coats," but they were well aware that the foreigners were most eager to get hold of some "unicorn" horn. The Eskimos had no qualms about selling their harpoon and dart heads and other bone objects, even whole tusks, and they bartered all this for nails, knives and needles.

Although British and Dutch seamen took advantage of every opportunity to barter tusks away from Eskimos, it was the Danes who cultivated and serviced the wider European market for narwhal ivory. As one seventeenth-century pundit, Thomas Bartholinus, declared:

> Nowadays the increase of [Danish] commerce with Greenland and Spitsbergen . . . has revealed the nature and frequent availability of the tusk. At all events, our merchants have filled whole cargo vessels with this alleged horn of recent years and would import it into Europe as genuine unicorn, had not the experts torn away the mask and recognized the tusk as originating from the ocean.

The "unmasking" of the unicorn and the increased supply of tusks probably softened the demand for narwhal ivory in Europe, but still there was a strong demand in the Orient, Russia, and the Middle East. An amusing story is told of how one Mukarrab Khan balked at paying 5,000 rupees for a unicorn's horn offered for sale by the British East India Company. Before buying it, he tested its effect on a poisoned pigeon, goat, and man. All died, and the offer was turned down.

The Oriental connection is especially intriguing. Although the Dutch established a lucrative monopoly on trade with Japan at the beginning of the seventeenth century, it was not until the late eighteenth century that narwhal ivory became a recognized item of licit exchange there. A botanist who visited Nagasaki in 1775 reported: "The Japanese have an extravagant opinion of [the tusk's] medical virtues and powers to prolong life, fortify the animal spirits, assist the memory, and cure all complaints." Narwhal tusks were apparently often used to ornament temples and other places of worship, and fancy dagger hilts were sometimes

carved from them. Pulverized or turned into shavings, narwhal ivory was sold as the wonder drug *ikkaku* in Japan as recently as the 1950s.

Even without the encouragement of Europeans eager to purchase tusks, the native people of Baffin Island and West Greenland would have continued to hunt narwhals. The narwhal's chewy skin, called *muktuk,* has always been a northern delicacy. Head and blubber oil from narwhals and other marine mammals made primitive dwellings glow with warmth and light during long winter nights. Narwhal sinews served as a tough but pliable thread for sewing garments and binding leather implements. Any parts of the carcass not consumed directly by people were fed to the sled dogs. Tusks, in this context, were little more than a byproduct. In some parts of the Arctic where narwhal tusks were readily available, they were the favorite material for harpoon shafts made and used by native hunters. As wood and iron became increasingly available, however, and as the trade value of narwhal tusks became more widely recognized, the incidence of natives using narwhal tusks to kill more narwhals lessened.

Narwhals were hunted occasionally by European and American commercial whalers, who from the seventeenth century to the early twentieth, sailed to the Arctic regions in search of bowhead whales. As part of his contract, one nineteenth-century Scottish whaling captain was guaranteed a 15 percent commission on any narwhal ivory he brought home. Commercial whalers generally harpooned "unies" for sport, but their preferred prey was unquestionably bowheads. Nonetheless, fancy walking sticks and even bedposts could be fashioned from narwhal tusks, and the blubber and head yielded a modest amount of fine oil. Commercial whalers seldom ate the skin in the manner of the Eskimos; instead, they brought it home to be tanned. "Porpoise leather," as the product was called, being tough, pliable, and waterproof, was especially popular for making boots and bootlaces. During the 1920s there was a special market in Peterhead, Scotland, for narwhal skins, which were shipped to France for the manufacture of stylish gloves.

However "incidental" narwhal hunting may have been to the commercial whalers, their presence in the Arctic led inevitably to the establishment of permanent trading posts where commerce in narwhal products was conducted on a grand scale, at least for a few years. Several free traders (as distinct from the giant Hudson's Bay Company monopoly) came to the Pond Inlet area on northern Baffin Island during the early twentieth century. They prospected for gold (unsuccessfully) and bartered tobacco, firearm ammunition, and, sometimes, winter rations for skins and ivory. Although we have only a sketchy record of these transactions, we do know that in 1912 three tons of ivory, probably most of it from narwhals, were taken out of Pond Inlet by the free traders. This amount would have required the slaying of about 600 tusked narwhals.

Henry Toke Munn, a Scotsman, made narwhal exploitation his particular specialty. With the help of a dozen native families, Munn operated a unique whaling station near Pond Inlet devoted entirely to the catching and processing of narwhals. According to an old Hudson's Bay Company report, in an "ordinary" year Munn's "factory" processed the oil, skins, and ivory of 500 to 600 narwhals.

An important aspect of the modern narwhal hunt is the loss of wounded and dead animals. The traditional Eskimo method of first harpooning the whales, then killing them, resulted in few such losses. Polar Eskimos of Greenland's Thule District still hunt narwhals this way, and they apparently lose very few of the animals they strike. In Canada, however, most hunters begin by shooting at narwhals with high-powered rifles, sometimes from long range, in hopes of crippling the prey to allow closer approach. As firearms have been available to the native narwhal hunters of northern Baffin Island since the late nineteenth century, these weapons have come to be regarded as essential tools of the trade. Consequently, wildlife managers and biologists, when assessing catch levels, must correct landed harvest figures to take into account significant hunting losses caused by the rifle-first technique. In our evaluation of the early twentieth-century removals by Eskimos on behalf of traders, we have had to assume that, in addition to those whales that were landed, some whales were killed and lost and some were mortally wounded. Also, as many untusked females as tusked males are usually killed, so that the volume of ivory traded grossly underrepresents even the landed catch.

One conclusion of our study is that the decade from 1915 to 1924 was prob-



Helen Gerson

ably a peak period for hunting mortality in the Baffin Bay–Davis Strait stock. Not only were Munn and the other free traders encouraging the Eskimos and supplying ammunition, but during this period there were also several exceptional catches due to ice entrapment that served to inflate the numbers. When weather conditions change abruptly at the end of the brief Arctic summer, narwhals sometimes become trapped in small pools of open water and are unable to swim under the miles of ice that have formed between them and the open sea. This phenomenon, usually referred to by the Greenlandic term *savssat,* enables hunters to kill large numbers of narwhals with relatively little effort.

In the severe winter of 1914–15 a series of *savssats* were exploited by hunters in Disko Bay, West Greenland. The slaughter was described in the restrained prose of M.P. Porsild, director of the Danish Arctic Station in Disko:

> Every man placed himself astride a hole with his rifle loaded, awaited calmly the arrival of a school, shot one of the animals—if possible a male with a tusk—and harpooned it immediately after the shot; or, if he were exceptionally clever, he simply seized the animal by its nostrils or by one of the flippers. He then enlarged the hole, pulled his prey up, and proceeded with the flensing. By this procedure the cleverest and coolest of the hunters got up to seven animals a day without leaving the spot first chosen.

Altogether, the local Greenlanders killed more than 1,000 narwhals that one winter. We have reason to believe that during the ensuing decade two *savssat* hunts in the northern Baffin Island region accounted for more than 3,000 killed narwhals. Adding the sum of these abnormal kills to estimates of the annual average catches for Canada and Greenland, we concluded that approximately 11,000 narwhals were removed from the Baffin Bay–Davis Strait stock by hunting during the decade from 1915 to 1924.

Munn left the Arctic in the mid-1920s, and in his absence the Hudson's Bay Company encouraged the people of northern Baffin Island to trap foxes with more zeal than they had under the influence of Munn and the free traders. They certainly did not stop hunting narwhals, but we have no record of subsequent catches that match those of the first three decades of the twentieth century. It is possible that the Great Depression and the Second World War, particularly in combination with the Hudson's Bay Company's emphasis on fur trading, had a negative effect on the demand side of the narwhal market. By the late 1960s, however, ivory prices were on the increase.

There seem to have been regular fluctuations in the price of narwhal ivory, but the causes are difficult to identify. The price of "unicorn" in Frankfurt apothecaries dropped from 64 florins per half ounce in 1612 to only 4 florins in 1669. Either consumers had lost their credulity or Danish merchants had glutted the market. In 1868 the British naturalist Robert Brown wrote: "The price of Narwhal's ivory . . . of late years . . . has risen prodigiously in value owing to the repair of the Chinese palaces, but is again falling."

We are particularly interested in the trend of the past twenty years. A former Hudson's Bay Company employee told us that in 1961, when he worked in northern Baffin Island, he was buying tusks from hunters for fifty to seventy-five cents a pound. By 1965, the price had crept up to $1.25, but in spring of 1967 there was a sharp increase. Suddenly, the hunter could expect $10 per pound for unbroken tusks. Since 1973, when narwhal ivory was selling for $15 per pound at Pond Inlet, the price has climbed dramatically. In 1974, it reached $25, then $30 in 1975, and $35 in 1976. Unbroken tusks were selling for $45 per pound in Pond Inlet in 1979, and the largest one sold in that year, weighing more than twenty-two pounds, fetched $1,043 for the hunter. A premium is usually paid for tusks longer than seven and a half feet and for the rare "double tuskers," or skulls with two fully developed tusks. We know of one such bidental skull that sold for $5,000 in 1979.

The prices paid to hunters, although they are, of course, related to prices paid by the ultimate consumers of the product, do not necessarily give an accurate impression of the value of narwhal ivory on the retail market. Frequently there are one or two middlemen between the hunter and the collector or the apothecary, and their high markup reflects the shadowy character of the enterprise. Unmounted narwhal tusks were sold at auction in London in 1978 for approximately £500 per meter. As far as we know the United States is at present the only country in the world where commercial exchange in narwhal products is illegal. The species is listed in *Appendix II* of the *Convention on International Trade in Endangered Species of Wild Fauna and Flora*, however, which means CITES export permits are required for narwhal products that cross international boundaries.

The International Whaling Commission's Scientific Committee recommended in 1979 that the narwhal and the white whale be added to the commission's schedule of whaling regulations. Such a move would have required member governments whose nationals hunt these species to implement conservation measures recommended by the commission. But the commission decided that according to the intent of the IWC's convention these two small cetacean species are not "whales." Therefore, narwhal and white whale conservation remains a domestic matter in Greenland, Canada, and elsewhere.

In 1976 Canada issued Narwhal Protection Regulations under its Fisheries Act. These limit narwhal hunting to



A hunter examines two adult males that were killed when they appeared in a narrow crack, or lead, in the ice. Since 1976, Canada has set annual quotas and limited hunting to permit-holding Inuit.

permit-holding Inuit, set minimum firepower requirements for weapons used in the hunt, and confer complete protection to mothers and calves. Hunters are required to make full use of killed narwhals, wasting no part that is "suitable for food." An individual hunter's tag must be affixed to every tusk and to the carcass of each tuskless female and immature male. Annual quotas are set for each settlement; the level is based on historic utilization patterns and presumed need.

In practice, this management framework leaves much to be desired. Kerry Finley, of LGL Environmental Research Associates in Toronto, was on the ice with Pond Inlet hunters during the 1978 and 1979 seasons. His record of their catch indicates that the Pond Inlet quota of 100 narwhals was exceeded in both years. Nursing females were taken, and utilization of killed animals was only partial. Most tusks were tagged and reported, but this only provides documentation of the adult male catch. During certain phases of the hunt, at least as many tuskless females were caught, but only a small percentage of their carcasses were tagged.

Our own experience suggests that the regulation forbidding waste is inconsistent with the changing patterns of resource utilization in today's Arctic. While much of the narwhal's carcass is suitable as human food, only the *muktuk,* and often not all of that, is saved by Canadian Inuit. They have no tradition of eating the meat, although the native people of North Greenland eat it fresh or dried. There are no working dog teams today in Pond Inlet or Arctic Bay, the two settlements that account for 75 percent or more of Canada's narwhal catch. In the past, much of the meat and viscera was used as dog food and the blubber oil was saved for domestic needs.

At present, the hunt for adult male narwhals in Canada is primarily a trophy hunt. Although it has some aspects of a subsistence enterprise, the cash incentive and the failure to make full nutritional use of the resource call into question the appropriateness of managing it as a subsistence hunt. As with all commercial fisheries, the sustainable yield should be assessed, and a regime that would insure against overexploitation should be instituted.

We do not know if a serious conservation problem exists. Today, the reported landed catch by Canada and Greenland combined is from 600 to 1,000 narwhals per year. Correcting this figure for the high rate of hunting loss due to sinking or severe wounding, annual hunting mortality alone may be well over 1,000 whales per year. Unfortunately, we are not certain that the whales killed by Greenlanders are from the same stock as those killed by Inuit in Canada. We have but a rough idea of how large a population is being hunted in either area. The actual magnitude of the kill and the effects of harassment on the fecundity and fitness of narwhals are completely unknown. Just as there is a need for biological research on narwhals themselves, there is a need to know more about the past and present character of the market for their tusks.

In managing the narwhal hunt, the fundamental problem of enforcement will always remain. The International Whaling Commission has no enforcement powers. It depends exclusively on the good faith efforts of member governments and, in the case of the narwhal, simply serves as a forum for discussion of scientific findings. Neither the Canadian federal government nor the government of the Northwest Territories is likely to invest the kind of resources required to police an activity so remote and individualistic. To an extent, the trade in ivory can be monitored and restricted. As scarcity, or *anticipated* scarcity, drives the purchase price higher, however, even this aspect of the hunt may become increasingly difficult to manage.

Even if a workable enforcement scheme could be devised, that may not be the best long-term approach to narwhal conservation. After all, some of the problematic aspects of the hunt, particularly the high loss rate and the waste of useful products, were caused, at least in part, by forces outside the Inuit community. Until recently, hunters were encouraged to purchase rifles and outboard motors, to replace their dog teams with snowmobiles, and generally, to adopt hunting habits designed to serve outside markets for ivory and skins. Now, abruptly in their view, the same hunters are being asked to abide by quotas that they consider arbitrary. Outside agencies that attempt enforcement, without giving hunters opportunities for consultation or even self-regulation, run the risk of working counter to the cause of conservation.

Education and cooperative decision making may offer more hope than direct confrontation. Kerry Finley met with the Hunters and Trappers Association of Pond Inlet after the 1979 season. He shared his findings with them and offered suggestions about how hunting practices could be improved. The hunters agreed to consider his recommendations, including the regular use of harpoons with floats to insure retrieval of shot whales, less hunting at the ice edge where sinking losses are high and females and calves are often taken, and restricted use of outboard motors in areas such as Tremblay Sound, which are frequented by females with calves.

It is the hunters themselves who must come to recognize their own long-term stake in conservation. The people of Arctic Bay and Pond Inlet have a diverse and rich resource base. Ringed seals, bearded seals, walruses, polar bears, wildfowl, caribou, and char still contribute to their subsistence, and the pelts of polar bears and arctic foxes add to their cash income. In addition, many men and some women are employed by government agencies or by mineral-extraction industries. Narwhal hunting is by no means essential to community survival. Rather, it is one of various sources of cash income and food. While many Inuit children of today are likely to adopt life styles very different from those of their parents, some will want to remain close to the land, maintaining by choice a tradition into which their parents were born. It would be tragic if this were made impossible by a previous generation's lack of foresight.

At long last, some of the world is becoming aware that there is a whale behind the tusk. And as appreciation of living whales increases, perhaps more of the money pumped into the Inuit economy will be for the capture of live narwhals for display and research and less will be for tusks removed from the jaws of dead animals. Development of a live-capture fishery on Baffin Island might simultaneously serve the financial interests of local Inuit and reduce hunting pressure on narwhals. Also, if many of the questions regarding tusk development and function are ever to be answered, captive subjects may be required for experimentation and close observation. □

The price of narwhal ivory is currently high, with premiums paid for tusks longer than seven and a half feet or for the extremely rare "double tuskers." This unusual specimen was taken at Pond Inlet, July, 1978.

Kerry Finley





Weeds That Ride the Rails

Railroads can be a good way for a plant to disperse—if it can take the heat and doesn't lose its head

by Robert M. Arnold

The sight, sounds, and smells of steam locomotives are among my earliest memories, and they still evoke a nostalgia for childhood hours spent on bridges or behind fences, watching trains go by. Today, despite the replacement of steam by diesel and the reduction in the frequency of trains, a walk along a railroad track is one of my favorite activities. While walking along a seldom-used rural line in Madison County, New York, several summers ago, I became aware of the profusion of weeds growing on the cinders of the railbed. I soon noticed patterns in their distribution and began to wonder about the adaptations that might be necessary for a plant species to colonize what seems, at first sight, such an inimical environment. What started as casual curiosity led to speculations that would become the major focus of my research.

As enjoyable places to study weeds, railroads have no equal for me. Just

looking along the tracks to where they curve out of sight gives me a powerful urge to find out what lies beyond the bend. While walking in pursuit of this ever receding goal, I find the opportunity to observe plants and animals and to enjoy the surrounding landscape, whether rural or industrial. Seldom-used rural lines are ideal for a study of plants because the relative infrequency of maintenance insures a large weed population. Urban settings, however, can be just as interesting, for even a well-maintained, plant-free main line in the middle of a large city usually has infrequently used loops or sidings on which plants can grow in astonishing numbers and variety.

The railroad line where I carry out most of my fieldwork crosses a swamp on a raised embankment, intersects several roads and farm tracks, branches to form a siding for a farm-supplies depot, goes through a cut in a hill topped by cornfields and pastureland, parallels a creek, and passes through stretches of both deciduous and coniferous woodland, all in the space of a few miles. Built on a bed of imported cinders or stones, homogeneous from one end of the line to the other, a railroad would be monotonously uniform without such variety in its surroundings. As the environment of a railroad changes, so does the vegetation adjacent to, and encroaching on, the tracks.

The number and diversity of plants along a railroad are generally greatest near an intersection with a road. Common roadside weeds, such as Queen Anne's lace (*Daucus carota*), ragweed (*Ambrosia artemisiifolia*), and wild parsnip (*Pastinaca sativa*), are well represented at these locations. The seeds of many of these plants can be found in dried soil material scraped from the underside of motor vehicles. Picked up from plants growing along roadsides, these seeds may shake loose as the vehicles bounce over the uneven road surface at a railroad crossing. Roadside plants that become established at crossings may then spread along the tracks in both directions as their seeds are dispersed by the wind or by passing trains. Weeds of dry fields and meadows are also abundant along railroad tracks close to crossings. At railroad crossings that transect farm fields, pastureland weeds, such as clovers (*Trifolium* spp.), horseweed (*Conyza canadensis*), and wood sorrels (*Oxalis* spp.), are found growing in larger proportion than roadside species. These species are undoubtedly spread to railroads by farm vehicles as they cross the tracks in transit from one field to another.

The best way to gain an appreciation of the changes in plant distribution along a railroad is to walk alongside the tracks from one road crossing to the next, especially if the distance between the two is at least a mile. Most of the plants are clustered within a few yards of the road edge at each crossing, with a long stretch of almost bare cinders between crossings. The few scattered plants that do grow along the tracks in these otherwise bare stretches usually belong to species different from those found near the road. Representative of the vegetation immediately surrounding the tracks, the plants that grow on the railbed may be grasses where the line is in a cut, horsetails near a marsh or swamp, or small tree seedlings, doomed to a brief life, where the line passes through a patch of woodland.

Plants that grow along railroads are subject to both stress and disturbance. Stress includes all conditions that act to restrict the growth of a plant. A shortage of water is probably the major stress factor for railroad plants because water drains quickly through the porous cinders or gravel, particularly if the railroad is built on a raised embankment. In addition, railroads are generally open, exposed places where the hot summer sun and the wind quickly dry the cinders, even after the heaviest of showers. After spending many July and August days bent over the burning hot rails collecting data, I have come to appreciate the baking heat that railroad plants must endure. Some essential minerals may also be in short supply because of rapid leaching. Shortages of



Robert M. Arnold

water and minerals are less likely to be a problem along railroads close to the edge of a road because there is commonly a layer of soil mixed in with, and sometimes completely overlying, the cinders at these sites. This soil is probably washed from the edge of the road by rainwater. I believe that the better growing conditions provided by this soil material, and the abundance of seeds deposited by vehicles, account for the large diversity of plant species close to the edges of roads.

Disturbance is at least as important as stress in limiting plant diversity along a railroad. As soon as it emerges into the air, a seedling runs the risk of being trampled underfoot, smeared with oil by a passing train, or eaten by an herbivore. To those individuals that survive these insults, the *coup de grâce* is delivered by the railroad company, which sprays weedkiller on the tracks every year, usually in midsummer. This maintenance practice means the end of life for the plants and the end of the field season for me. More than any other disturbance phenomenon, spraying determines which species of plants will flourish on railroad tracks from year to year. It prevents the establishment of plants, including most perennials, that flower and set seed only after an extended vegetative period, and it selects for those plants, primarily annuals, that grow quickly through a short vegetative phase and then flower and set seed early in the summer. By the time the seeds of these annuals are ready to germinate at the beginning of the next growing season, the weedkiller from the previous year will have decomposed or been leached out of the surface layers of the cinders. Once a railroad is closed, however, disturbance becomes much less severe, and perennials, with their ability to overwinter, will eventually outcompete annuals, which must start anew from seed each year.



Tall plants, such as wild parsnip, are at a distinct disadvantage on an active railroad. If trains do not pass by too frequently, however, some individuals can set seed before they are decapitated.

On an active railroad, plants of small stature have a competitive advantage because tall individuals are likely to be decapitated by a passing train. Some tall species, such as wild parsnip, Queen Anne's lace, and common mullein (*Verbascum thapsus*), do grow on railroad cinders. On an infrequently used line, individuals of these species may grow to be several feet high in the interval between one train and the next. The first train to travel along the line after such an interval chops the tops off the tall shoots. This does not necessarily spell doom for the plants: I have often seen individuals of wild parsnip and Queen Anne's lace flowering on uncharacteristically short shoots that grew following decapitation of the first-formed, long shoot. Mullein, however, does not have such a mechanism of regeneration. The rosettes of leaves formed by this biennial in its first year grow well on railroad cinders, but individuals that grow too close to the tracks will probably have their single flowering shoot cut off by passing trains long before they can set seed.

Of all railroad weeds, dwarf snapdragon (*Chaenorrhinum minus*) has interested me the most. In the United States, this species grows more abundantly along railroad tracks than anywhere else, contributing greatly to the appeal it has for me. I have come to admire the tenacity with which this tiny, beautiful flowering plant flourishes in the seemingly inhospitable environment provided by the dry, sun-baked cinders of a railroad. Like most weed species of railroads, roadsides, waste areas, and fields, dwarf snapdragon is not native to the United States. Ecologists believe that native weeds are the first to colonize newly disturbed areas of natural vegetation. Nonnative weed species follow, usually with human assistance, attached to clothing, footwear, vehicles, and equipment, for example. Frequently disturbed areas generally have more species of introduced weeds than of native weeds.

The original home of the dwarf snapdragon is believed to be the Mediterranean region of Europe; from there it has spread to, and become locally abundant in, dry fields and railroad cinder ballast throughout most of Europe. Before railroads existed, this species was probably confined to dry, gravelly soils in fields and waste areas. The building of a continental network of railroads during the nineteenth century provided avenues for the snapdragon's widespread dispersal throughout Europe. Dwarf snapdragon was first recorded in the United States at Camden, New Jersey, in 1874. Presumably, the species made the trans-Atlantic crossing as seeds carried along with the cargoes of ships. On its arrival in the United States, the plant encountered an existing railroad network, and since the latter part of the nineteenth century, dwarf snapdragon has spread relatively rapidly—as far as Kansas and Nebraska in the west, North Carolina in the south, and Quebec and Ontario in the north.

The reported spread of dwarf snapdragon along railroad tracks prompted me to investigate the efficiency with which the seeds of this plant are dispersed by passing trains and to compare this mode of dispersal with natural phenomena such as wind and rain. I quickly found that rain splash is not a mechanism of seed dispersal in this species: the two openings in the wall of each mature fruit, through which the seeds escape, close up completely when the fruit is wet or exposed to conditions of high humidity.

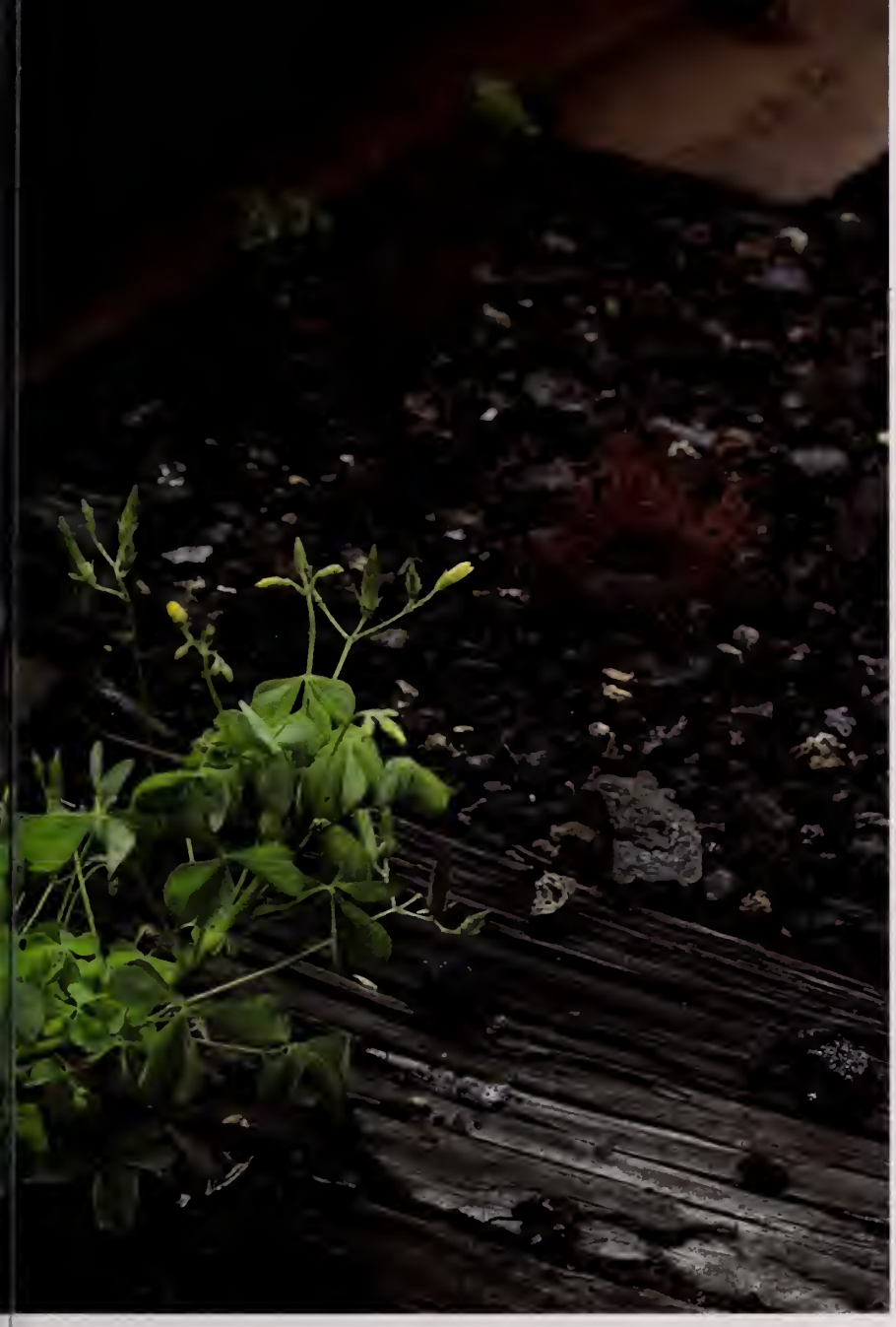
For the experiments on wind dispersal, I set up sticky traps around plants that were growing near, but not on, railroad tracks and left them for at least five days. Each trap consisted of a strip of filter paper painted with a thin layer of melted petroleum jelly and glued to a wooden board that lay flat on the ground. I arranged similar traps around other plants that were rooted in the cinders between the rails and in the path of approaching trains. Normally, most seeds that fall on the highly porous cinders quickly percolate down



through the interstices of the cinders, where they are protected from agencies, primarily the wind, that might otherwise carry them farther. Also, under most conditions, seeds that remain on the surface lie within a laminar boundary layer of still air, and only a very high wind can move such small objects (0.6 mm long and 0.4 mm wide). Consequently, I reasoned that my traps would not artificially restrict the dispersal of seeds.

I found that trains are much more effective than the wind in dispersing seeds of dwarf snapdragon for long distances. Despite the periods of strong to gale-force winds that occurred during some of the wind-dispersal experiments, in no case did I find seeds farther than eight inches from the parent plant; most landed much closer. By contrast, a locomotive and eight boxcars, traveling at about twenty-five miles per hour, dispersed half the seeds within eight inches of the parent plant and the rest up to five feet away. Some seeds might be carried even farther if they stick to the wheels or underside of a train and are dislodged later; the faster the speed of the train, the farther along the tracks it will carry seeds. Mark Widrlechner of the University of Minnesota has suggested that parts of mature plants may break off and be carried along the tracks like tumbleweed, dispersing seeds as they go. Short-range dispersal of seeds by the wind and passing trains may allow dwarf snapdragon to exploit locally favorable areas, and trains may also facilitate the long-range spread of the species along the tracks to new areas.

These findings fit well with the observed distribution of the dwarf snapdragon in the United States. In the Mediterranean region, the species spread to newly built railroads from nearby fields and waste areas. In the





Passing trains may brush against dwarf snapdragon plants, above, dispersing seeds along the tracks. Wood sorrel, left, and other pastureland weeds are common where railroads and farm fields intersect.

rest of Europe and in the United States, however, I believe the spread has been in the opposite direction—from railroad tracks to nearby fields and waste ground. This lateral spread, dependent on the relatively inefficient wind dispersal of seeds, has not progressed very far in the United States, so that the species is still restricted to railroads and adjacent areas. My belief in this lateral spread received a temporary setback when I found a large colony growing in a patch of waste ground located more than eight miles from the nearest railroad, a distance many orders of magnitude greater than can be explained on the basis of wind dispersal. My faith was restored, however, when I consulted a topographic map and found that the New York, Ontario, and Western Railroad, which closed in 1957, used to pass through the middle of the area now occupied by the weed lot.

Having established how dwarf snapdragon spreads along railroad tracks, I then began to investigate how the plant manages to thrive in its apparently hostile environment. My first interest was in finding out how many of the newly germinated seedlings, which appear in large numbers in late spring, survive the stresses and disturbances of a railroad long enough to set some seed and thus be represented in the next generation. I followed the fate of a large number of individually marked plants for four months, expecting that lack of sufficient water would be the chief cause of premature death, especially among the highly vulnerable young seedlings. What I found was completely unexpected: the vast majority of deaths were the result, not of water shortage, but of herbivory. Sometimes just the tops of plants were nipped off or small bites were taken out of leaves; at other times, whole plants were eaten. Occasionally, all that remained of my carefully marked seedling was the loop of colored thread that I had tied around it, found lying on the cinders. I failed in my attempts to catch the culprits by baiting live traps with tender dwarf



snapdragon seedlings, but from my observations of the animals prevalent in the vicinity of railroad tracks, I suspect that edge feeders, such as woodchucks and rabbits, were responsible for much of the herbivory.

Whatever the identity of the herbivores, they cause a catastrophic mortality rate among seedlings: less than one seedling in thirty survives long enough to set some seed. Plants that do survive this early predation are seldom prey to herbivores once they have formed mature fruits, perhaps because they are less palatable than when they were younger. In consequence, these plants will most likely survive to the end of the growing season several months later. They may grow to be relatively large (eight to ten inches tall, with extensive branching), and each may produce many thousands of seeds. My present record holder is a specimen I found at Corning, New York, in July 1979. This splendid individual was thirteen inches tall, had sixty-two branches (giving a total stem length of almost fourteen feet), and bore 63 flowers and 383 fruits. Within its reproductive structures, even if no more developed, this plant could produce more than 24,000 seeds! The record holder for smallest size at maturity was truly a dwarf snapdragon, just two-thirds of an inch tall with a single flower at the top of its unbranched stem.

The finding that lack of sufficient water is not the principal cause of seedling mortality does not eliminate it as a source of stress for railroad plants. The cinders become so dry and dusty after just a few days without rain that water shortage must be a severe problem during much of the summer. Since competition for the small quantities of water present will be particularly intense where plants grow close together, I was not surprised to find that tall, reproductively successful dwarf snapdragon plants grow well separated from other plants and that where the plant grows in dense patches of vegetation, only small individuals with few reproductive structures are found. Dwarf snapdragon is invariably absent from crossings that are heavily overgrown with other species of plants. These observations suggest that the species is a good colonizer of bare cinders but either fails to grow or is outcompeted by other plants in areas of the railbed that hold more water, perhaps because of local accumulations of soil.

Dwarf snapdragon seeds will germinate only when water is present in small quantities. Seeds placed on moist filter paper absorb water and rot; none of them ever germinate. The only time I have ever succeeded with a laboratory germination experiment was when I planted seeds in pots containing railroad cinders and watered them very sparingly. Much work remains to be done, however, before I can understand how this plant, once it has germinated and taken root, manages to survive without rain for long periods, sometimes several weeks. Its tiny root system, penetrating less than one inch in any direction into the cinders, can have access to water for only a short period after rain or, during a dry spell, from the early morning dew. Water loss is no doubt minimized by the small, narrow leaves, but other anatomical modifications common to plants of dry habitats—sunken stomata or a thick, waxy cuticle covering all external surfaces—are absent in this species.

Dwarf snapdragon plants that survive the attentions of herbivores and are not overcome by a shortage of water have only a short period in which to set seed before they are killed by herbicides. I found that all individuals that grew to a large size and produced a large number of seeds began flowering when they were only about one to two inches tall and before they had begun to branch. I have never found a dwarf snapdragon plant taller than about two inches that did not have flowers or fruits. Clearly, one reason dwarf snapdragon—and no doubt other railroad weeds—can be found at a given railroad crossing year after year, despite the weed-control program of the railroad company, is that most individuals set seed after a short period of vegetative growth and before the midsummer weedkiller application.

Before a flower can give rise to a mature fruit, it must be successfully pollinated. Wind pollination, common among many successful weed species, is prevented in dwarf snapdragon by the enclosure of the male and female reproductive structures (stamens and pistil) of each flower in a two-lipped floral tube. Several aspects of the flowers suggest insect pollination: the colorful appearance of the flowers, the arrangement of the lower lip of each flower as a possible landing platform, and the presence of two magenta-colored stripes, richly clothed with glandular hairs, on the inside of the lower lip. Like a pair of fluorescent arrows, these stripes, which are sufficiently bright to be visible from outside the flower, point the way to the nectar and pollen in the interior of a flower. Yet, despite long periods of observation, days and weeks went by without my seeing a single insect as much as pause at the sight of the beckoning flowers. My patience was finally rewarded, however, one hot and sultry July afternoon when I saw a small bee in the act of burrowing headfirst between the lips of a flower. I watched this insect emerge covered with a whitish dusting of pollen and then fly off to other flowers where it repeated the process.

Subsequent observations showed that these bees (family Halictidae) fly only on the hottest of midsummer days. Knowing that the petals of dwarf snapdragon wither and fall to the ground within twenty-four hours of opening, I reasoned that these insects must pollinate only a very small proportion of the flowers that open during the whole summer and that self-pollination must be the most frequently adopted mode in this species. To test the ability of dwarf snapdragon to self-pollinate, I tied small muslin bags around several flower buds, thus denying access to would-be pollinators. I removed the muslin bags after the petals had withered and become detached from the ovary of each flower. Flowers treated in this way formed mature seeds indistinguishable in all respects from those produced by untreated flowers, evidence that successful self-pollination can occur. Thus, dwarf snapdragon has the best of both worlds. When growing alone or in the absence of insect visitors, an individual plant can pollinate itself. With the aid of bees, the plant can also exchange pollen with other snapdragons, a less reliable method of reproduction in this species but one that insures genetically variable offspring.

While this article was in preparation, I learned that the railroad line where I carry out my research is to be closed in the near future. Although the railroad enthusiast in me laments this shutdown, as an ecologist I see a rare opportunity to study the changes in vegetation on the cinders in the absence of maintenance activities. What will become of dwarf snapdragon along this line? I predict it will be outcompeted by other annuals and by perennials as the railbed becomes more and more overgrown. Thus, the snapdragon may vanish from an area in which it has held on to a precarious existence for many years. I will miss this little plant even more than the trains that spread it so effectively. □

Jay Maisel



I'd Rather Be a Messenger

New York City's bicycle messengers prefer the independence and excitement of dodging traffic to the routine of a nine-to-five job

by Jack M. Kugelmass

photographs by Yoav Levy

"I'm speeding across town, weaving in and out of traffic. I've already done sixteen runs. Good messengers do twenty-five, but I'll settle for twenty. I'm tired, and it's late. But I'm trying for that magic number. So I pedal harder. I'm pushing, trying to reach the front of the line of traffic. As I move up to take the lead, I no longer feel tired. My mind is working fast, checking out openings. I hug the curb, keeping clear of the traffic. But I'm riding too close to construction debris: there are mounds of dry cement powder on the road. Before I realize what's happening, the bike skids out of control. I pump the brakes but still can't keep my balance. I can feel myself going down. The impact on the cold pavement overwhelms me. I remember there is a truck behind me, but my body won't move. My head can turn, so I twist it backward and stare helplessly at the driver seated high above me. I feel like a conquered gladiator. The driver motions to me to lie still,



not to move until I'm ready. The shock passes. I pick myself up unsteadily and walk my bicycle over to the curb. Still shaken, I get back on and begin to ride, a little slower, a little less arrogant, no longer trying for that magic number."

So ended my first week as a bicycle messenger. I took the job in order to study bicycle messengers, but after a day or two I had become more concerned with magic numbers than with researching the story. Although it made me hesitant to continue riding, the accident on the cement powder put me back on the right path: I began to concentrate on meeting and arranging interviews with other messengers. I also began to understand the attractions of "messengering" as a way of life, particularly the romance of danger.

The 600 bicycle messengers who ply New York City's Borough of Manhattan are a diverse group of people. They cross over class, ethnic, and racial lines, and although a small minority, there are women riders too. But all share a kinship with the heroes of the Wild West. They are romantic adventurers who prefer the exhilaration of danger to civilization's deadening routine.

The streets of Manhattan are a frontier, a no man's land. In the main business districts, they interrupt the flow of civilized behavior, contrasting with the sterile, almost hermetically sealed world of high-rise offices. If there are laws regulating New York City traffic, they are barely enforced. Bicycle messengers are fast and contemptuous of the rules. They intimidate pedestrians and alarm the drivers of other vehicles competing with them for space on the road. Messengers sometimes wear outlandish clothes that go well beyond what is functional attire for riding in town. Some wear gas masks to filter out particles of dirt from automobile exhaust fumes. Others wear special racing gloves from which their knuckles protrude in a vaguely menacing way. And they all have one identifying mark—an oversized bag slung behind their backs.

Bicycle messengers consider themselves part of an elite. Their sometimes stimulating and often hazardous work puts them in a different class from Manhattan's thousands of foot messengers, who are mostly unskilled youths, mentally impaired persons, or older men, past retirement age.

Speed and maneuverability make the bicycle messenger an indispensable part of New York City's most time-conscious and competitive industries—film and advertising. The public at large, however, gives scant recognition for the service they provide. Because messengers generally look scruffy, people respond to them accordingly.

Working conditions in the industry do not support the bicycle messengers' sense of their elite status either. Messengers are independent contractors. They are not eligible for vacation pay, unemployment compensation, or acci-

dent insurance. Some messenger companies blatantly miscalculate paychecks. They refuse to compensate the messenger for dispatchers' errors or they penalize riders for lateness.

Despite the drawbacks, the pay can be good. Although many messengers make less than $150 per week, good ones earn close to $250, and ace riders earn $350 or more. At least one rider, by nibbling nuts and dried fruits throughout the day and seldom stopping to rest, makes $500 a week. Good messengers do close to twenty-five runs per day. Most earn $2 per run, or about half the gross fee. Rates vary according to the distance of the run, the size and weight of the package, and whether the client requests a "rush," that is, immediate delivery.

Part-time riders are almost always docked 5 percent of their week's earnings for each work day they are absent. Thus, a rider who works one day a week receives as little as 30 percent of the delivery fee. Messenger companies encourage part-time riders, both to guarantee enough personnel to handle the volume and to lower the base rate. But the good riders, particularly the ace riders, are given preferred treatment. They receive a higher percentage of the gross and they get the most profitable runs—those that are shortest and closest to one another. At least one company tries to minimize the exploitative aspects of the industry by providing a flat rate of payment that applies to all riders. This company also provides compensation for job-related injuries and gives carte blanche to its riders to talk back to difficult clients.



Using a client's phone, a messenger checks with his dispatcher to get additional assignments. Messengers are often selective, since they profit most if the runs are close together and can be combined.

Earning a good living at messengering is by no means easy. Despite a frenzied effort on my part, I was consistently unable to earn anywhere near the middle or higher income range that the better messengers earn, so I quickly abandoned any idea of messengering as a career. My age (thirty) was not a factor. Although most messengers are in their twenties, some of the better messengers are in their thirties, and a few are in their forties, fifties, or sixties. Most people who become bicycle messengers do so because they are desperate for a job, and they give the work up after a short while just as I did. Only a small proportion continue to ride on a long-term basis.

Long-term messengers share certain character traits in common. Like the heroes of the West, they are mavericks, resentful of conformity and rebelling against it. Often, they are loners who have run into trouble while pursuing more conventional careers. For them, the excitement of bicycling helps to counter the reality of defeat.

Andy is a former psychiatric social worker who abandoned his career after his plans for improving home care for patients were thwarted, he felt, by his coworkers' lack of motivation. Andy's boss, Hank, lost his job doing quality-control research because of his disagreement with the "proper" corporate attitude. Both maintain they are unable to deal with situations that require submission to authority:

HANK: I never got along with bosses. Even when I get along with them, I never really get along with them. I always think of myself as an amiable, compliant, even somewhat passive person. But conflicts inevitably arise.

ANDY: By the way, forget it.

HANK: I'm not amiable? I'm not compliant? I'm not passive?

ANDY: No, you're amiable. But you're neither compliant nor passive by any means, and you know it.

Hank began working as a messenger at age forty-two. Today, eight years later, he is the owner of a rapidly growing



A bicycle messenger delivers reels of film for processing. Indispensable to such time-conscious industries as film, advertising, and publishing, messengers must learn to cope with clients' anger over late delivery.

messenger company. It is one of the few companies that are highly regarded by messengers. Hank treats his riders well, and although he frequently complains, he tolerates their eccentric or even erratic behavior, largely because he identifies with it. Andy is less tolerant of the nonconformism. His frustration results from his attempt, while working at another messenger company several years ago, to organize a union. He concluded that messengers have an almost religious devotion to their independence:

> I became convinced that if you told four bicycle messengers that they would each get a thousand dollars if all four of them showed up at a particular street corner at a particular hour, thereby producing a community experience, you could be damn sure that they wouldn't be able to do it. That they would *not* do it.

Sometimes messengers have left former careers for reasons other than personality conflict. Donald, a 41-year-old messenger, is able to support his wife and 15-year-old son on his earnings. Donald was a film processor, but abandoned his profession because, as a Jehovah's Witness, he could not condone the role he played in producing pornographic material. As a messenger, not only does he feel his conscience is clear but he can also leave work at his own discretion to devote more time to proselytizing for his creed.

Messengers relish their independence: "You basically don't have to answer to anyone." One former messenger, who now works as a graphic artist for a small publishing company, misses her previous life style: "When I go down the street, I'm jealous of the messengers. It's really a lot of freedom."

Although taxi driving is a common occupation of many New Yorkers who are unable to find work in their fields, bicycle messengers find the idea repugnant. They dread the loss of freedom and maneuverability. They take special delight in their ability to weave in and out of traffic, ride the wrong way down one-way streets, and cut through the bottlenecks that regularly stall midtown traffic. Bill, a former doctoral student in experimental psychology, compares the skills for messengering to those needed for slalom skiing:

> There are a lot of things involved in moving quickly and watching the road surface and watching cars and avoiding cars. Of course, you have to react to all these things as soon as they happen, as quickly as possible. And that involves timing and slowing down and braking and so forth. And cadence, of course, that's very important. And you're reacting to the traffic—you have to look ahead and kind of predict where openings are going to be and where are the best places to go.

Traffic is not the only challenge messengers must face. Bicycle messengers are usually given several runs at a time. Although the dispatcher tries to assign runs that are relatively close to one another, the messenger must decide the best pickup-and-delivery sequence, calculating the seemingly illogical system of avenue addresses. Messengers have to think ahead and plan the fastest possible route through the maze of one-way streets. If a package is delivered late, it is the messenger who receives the brunt of the client's and the dispatcher's wrath.

There is also skill involved in maintaining the bicycle. Messengers consider their bicycles to be tools, and many devote time and effort to drying them after a rainstorm, cleaning off excess grease, and overhauling moving parts. Some have an almost spiritual relationship with their bicycles.

In the course of my work I saw dozens of messengers on track bikes: ex-



Messengers are proud of their role in the city's bustling economy. An increasing number ride stripped-down track bikes for an added sense of accomplishment.

tremely lightweight racing bicycles that have been stripped of all excess parts, including brakes, gears, and derailleurs. Because the rear wheel of a track bike is "fixed"—so that the wheel and the pedals always turn together—these bicycles are commonly known as "fixes." They require a good deal of muscle power to ride and even more to stop because braking is done by checking the forward thrust of the pedals. Track bikes seemed ill-suited for frequent stops and starts, so I was curious why messengers would ride them. To find out, I often had to weave in and out of traffic at breakneck speed, trying desperately to keep pace with speedier riders while screaming at the top of my lungs to catch their attention. I caught up with Zowie, a 23-year-old former recording technician, during a winter rainstorm. Like many others I spoke to, he favors the track bike because he feels more in harmony with it, more a part of the bicycle. Abdullah, a young black Muslim, uses Zen concepts to underline the value of riding a "fix":

It's hard. It makes your life harrowing every day. It's part of Zen. You push. You flex and you push. And you tense. You realize that you're keener after you've been through it. You're a bit keener and a bit swifter and a bit more relaxed about what just might come at you in life.

One of the most difficult tasks of messengering is to maintain an element of self-control. Bicycle riders are extremely vulnerable and cannot withstand even the slightest contact with a car, let alone a serious collision. Given the difference in weight between cars and bicycles, there is no point in forcing a confrontation, no matter how provocative a taxi- or truck-driver might be. Like Abdullah, Joe believes that the control that messengers exercise has its wider applications:

It carries over into your regular life with people. You're able to watch people. You know what's developing as they're speaking to you. And you see the reasons behind it. And you don't just react to it. You digest it and get to the reasons behind it, and talk rational.

Messengering is mentally as well as physically demanding. Messengers learn to keep an inner core of themselves alert and aware regardless of what they are doing. They develop a sixth sense for when to focus all of their attention on the road.

Despite the apparent risk, the use of drugs, especially marijuana, is a common feature of the messenger industry. Overhearing a conversation between two riders about obtaining some hallucinogenic mushrooms, I asked them whether getting stoned on the job created any problems. Both felt that the most serious problem was the tendency to get confused and either mix up addresses or forget a destination altogether. Another messenger joined the conversation, stating that although when he first started riding, he would not use drugs, he now believed they have beneficial effects. He described how his attitude changed:

So here it is, Friday morning, everyone's getting paid, and whatever their bag is, they're getting stoned. That was the first time I got stoned, you know, on the job. . . . I remember getting on the bike, riding on the sidewalk. There's a canopy on the block, and I rode between the poles of the canopy into the street, and I felt like I was entering an arena. And all of a sudden, everything that I learned the past month—I wasn't even thinking along these lines—all of a

sudden, everything I learned came together for me, all the traffic patterns and everything else. I had no objection to getting stoned on the job after that.

Even without the stimulation of drugs, messengering is seldom boring. The city is constantly changing, and the people who live within it are always on the move. There is also an element of chance that determines the number of runs, the location of the pickups, and the routes to the deliveries. Riding itself provides a constant thrill. Greg, a thirty-year-old actor trained at the Juilliard School, loves the speed:

I can get up to forty-five miles per hour down Second Avenue. It's a very pure feeling, getting into the groove of riding, where you know that you're on the road keeping pace with all these big machines that can kill you. All you have on your side are your ears—it's a very aural job, because you hear what's happening behind you. And you just know because of your speed and your skill, you can keep up with the cars and cabs and buses and get there faster than anybody. That's great. That's satisfying.

Messengers who live outside Manhattan often cycle to and from work each day. Most of them enjoy riding. As one puts it, "It sure beats working for a living." Another, David, is nearly effusive:

On a good day, you know, there are actually times when I almost whistle while I'm working. I'm so pleased with it, I'll say to myself, "You know, I'm riding around town. I can't believe they're actually paying me to do this. I'm getting exercise, the sun's out, and there are people sitting inside offices wishing they were outside."

The experience of joy from work contrasts sharply with the deadening quality of most work in our society. Perhaps it comes from experiencing the world directly, rather than through an office window or a car windshield. As Joe explains:

You get to greet the morning. There are all these different angles of life. I mean, the city's beautiful. You watch it change. It's a question of stone canyons. The light plays on them, and it's different light all day. You know there's a real connection with being alive, especially when you're coming out of the offices.

Messengers have a sense of superiority over most people they come in contact with, particularly office personnel:

You get a lot of secret envy, you know. They think you're a little crazy in bad weather, but you're free at the same time because you can stop and get off any time you want. A lot of times you're getting treated very poorly by someone, but in the back of your mind, you know you're making more money than they are. And you're probably happier in what you're doing than they are.

Long-term messengers are seldom lacking in other skills. They tend to be opt-outs rather than dropouts. Among them are Ph.D.'s and professionals, such as social workers, writers, and musicians. They are often people who are seeking other than nine-to-five jobs or are unable to fit the regimen of professions for which they trained. They have in common an uncertain future and often a past in which failure figured more prominently than success. For the latter group in particular, riding has become an important source of pride. Initially bitter and angry at not having achieved success in their careers, they find relief in the physical aspects of messengering. Cycling whips bodies into shape. "It has a sort of narcotic effect too," Hank explained. "It drains away inner anger and frustration. It's very hard to be angry when you're physically exhausted."

Messengering also offers an opportunity to complete a job: "One thing about physical work—it's real." Those who turned to messengering from academic work experience particular de-



David writes up delivery tickets before setting out on his bicycle. With a Ph.D. in political science, he is one of many people with academic backgrounds who take delight in the simple tasks of "messengering."

light in doing a simple task—making a delivery—and never feeling that it somehow could be done better. David was a student of political science when he turned to messengering to support himself. Today he has a Ph.D. from Columbia University, and he publishes academic articles on psychohistory and totalitarianism. But he disdains university work:

I did this one library job at Columbia where I was correcting conference papers. And I always had guilt feelings about the job because I never felt that I was doing it right. There was always more I could do. Whereas messengering, you pick it up and you deliver it. That's it. It's over.

Nonacademic types, such as Joe, also appreciate the detachment from responsibility:

I feel in sync with it, if you can call that satisfaction. I don't feel anything emotional at all. It's simple, it's like a very simple process: bing, bing, bing, that sort of thing—like a pinball machine, bouncing off the thing. Bing the right thing, racking up the numbers; that's exactly how I feel.

Remaining calm despite aggravation can be difficult for those who consider the job a step down from a previous position. My own sense of resentment at being treated as a messenger by clients made me all too ready to use my title, Dr., as a weapon, to shock the people I was serving. When I asked David how he dealt with the problem, he agreed that his own career expectations had, at first, made him sensitive to possible slights:

The thing I found about messengering is, if you let things like that get to you, you screw up. It's dangerous. It's literally dangerous. You start thinking about it. You start talking to yourself, and that's when you lose concentration riding and you have accidents. So I found that I really have to "swallow bitterness," as the Chinese say. And I do it pretty well. I'll talk to myself, you know, for the length of time it takes to get down the elevator, and then I wipe it out. I go on to what I was doing before. I find that if at the end of the day I made a decent amount of money, it's all forgotten.

The possibility of death is never far from the minds of bicycle messengers. Most long-term riders have seen other cyclists seriously injured on the road. Although he dismisses the gravity of most injuries, Bob, the manager of Hank's messenger company, says there are two kinds of cyclists—"those who have gone down and those who are going to go down." The danger might be lessened if cyclists wore helmets, but few messengers will do so. "I have to admit," one messenger responded, "I see people wearing helmets on bicycles, and I feel sort of contempt for them. A snickering contempt." For some, the refusal to wear helmets is like wearing an elite uniform. It adds drama and excitement to life, and it does so by emphasizing the nearness of death.

Every once in a while a truck comes out of the shadow. I don't know where from, but it almost takes my life. And you know, it's interesting—it's nice to feel alive again. You get that rush. You look at the sky, and you realize you could have cashed in your chips right then and there. It's a nice feeling. It's like being on the edge.

The sense bicycle messengers have of being an elite probably has a lot to do with the danger they face. They are like the pony express riders of yesteryear. For some, jumping a light is like a daring dash across the plain to the mountain pass. Even the weather plays a role in shaping their image. Long-term riders see themselves more in harmony with the weather than battling against it.

Bad weather sets the stage for the heroic aspects of messengering. "The worse the weather, the better," says one messenger. "Snow is better than rain." In bad weather, the hero-messenger is in great demand. "Somebody's got to do this stuff," says David, "and if I wasn't doing it, there wouldn't be anybody to take my place." David's most heroic moment occurred several years ago when the city's surface transportation system was virtually paralyzed by snow:

There was one other bike along the road. I had to take three or four runs down to the Battery [Manhattan's southern tip]. I got down to the Battery, and it was like Antarctica. Nothing was visible, and the snow was drifting four to five feet. Finally, I began to try to come back uptown, up Third Avenue—it's called the Bowery down there. And I just said, "Screw it!" and collapsed into a snow drift. I was just going to go to sleep and die. Fortunately, a man in a snowplow came along, and he saw me waiting there and he motioned to me. And I just followed behind him back to midtown. It was really lucky.

On Friday evenings I would sit in the basement of Nathan's Delicatessen on 43rd Street and Broadway and trade stories with other messengers. One Friday I sat drinking beer and massaging the toes that I had twisted in a fall from my bicycle several hours earlier. I was worried about my tape recorder, uncertain how well it had survived the fall, and I was worried about myself, uncertain how much longer I could face the hazards of riding. Cochise, a long-haired hippie type, sat at the opposite end of the table eating a bizarre combination of packaged health food and garishly colored pink cotton candy. His jaw still bore the scar from a fracture he received in a collision with a taxi. I had heard about Cochise from the other messengers. I introduced myself, and he responded by pointing to his sockless feet—his trademark. "Why don't you wear socks?" I asked, horrified by the thought of riding in winter without them.

Able to weave through traffic at high speed, bicycle messengers derive satisfaction from competing with heavy vehicles. The dangers of street traffic and poor road conditions add tension and excitement.

I don't like socks. I don't like putting them on. I don't like taking them off. I don't like going through them in the morning. I don't like buying them. They rip. They shrink. They pull. You sleep overnight somewhere, you got to put the same pair on the next morning—ugh. You wear them overnight—ugh. And another thing: No matter how damn cold it gets, no matter how high the snow is, it's a little bit of summer. I'm not wearing socks, man. You understand? It's a little bit of inner strength too.

Perhaps a need to show inner strength has its roots within a deeper sense of defeat. Messengers are generally acquainted with defeat before they become messengers, and their vulnerability to cars, mechanical breakdowns, bad weather, and company mistreatment makes them continually familiar with it. But messengers also have a sense of victory, a sense fierce enough that once it is achieved, they will not part with it. "Do we all like going to work every day?" Cochise asked, determined to put an end, once and for all, to my questions.

We don't all like going to work every day. It's something you gotta do. I just look around this restaurant. There's not another job anyone has in this restaurant that I would want. You take me outside. Look up and down the street. All these people got occupations that they're doing, right? All right, some of them are just walking by, we don't know what they're doing. But you show me just about anyone who's working out there. I don't want any of their jobs. If I gotta work, I'd rather keep this. □



THE MARKET

Art

AMERICAN INDIAN CRAFTS: Pueblo pottery, Hopi 2nd and 3rd Mesa plaques; Kachinas; old and new rugs. No catalogue. One-of-a-kind pieces; individually photographed. Most priced $100/up. Write for photos and data, specifying interests. Box 5896, Sherman Oaks, CA 91413 (213) 789-2559

AUTHENTIC IROQUOIS Gajesa (Bushy Head) Mask, $38, request photo, McCoy Imports, Liberty, NY 12754

FAMOUS INDIAN ARTIST, Jim abeita. Limited edition prints. Free brochure. Kiva Gallery, 202 West Highway 66, Gallup, NM 87301 (505) 772-5577

FREE! COLOR BROCHURE, Large National Park Prints by M. Woodbridge Williams, Photo Classics, Dickerson, Maryland 20753

LIMITED EDITION LITHOGRAPHS. Free brochure. 4 Historic Churches of New Mexico and other subjects. Legacy Editions, 510 Second St., NW, Albuquerque, New Mexico 87102

WHALES of hand-carved pine. Illustrated brochure $1.00. Doug Lind, P.O. Box 74, Burlington, WI 53105

Book Publishers

PUBLISH YOUR BOOK! Join our successful authors. Publicity, advertising, beautiful books. All subjects invited. Send for fact-filled booklet and free manuscript report. Carlton Press, Dept. NHH, 84 Fifth Avenue, New York 10011

Books

BOOKFINDING. Librarians search worldwide titles or subjects plus 150,000 indexed stock. PAB, 2918 Atlantic, Atlantic City, NJ 08401 (609) 344-1943

GET SMART CHEAP! Save up to 90% on thousands of brand new hardcover & paperback sale books & records. Many exclusives in History, Science, Reference, Art, Literature, Philosophy, Psychology, Reprints, and much more! Write for free catalogue from the world's largest bookstore—Barnes & Noble, Dept. G800, 126 Fifth Avenue, New York, NY 10011

PUBLISHERS' OVERSTOCKS, BARGAIN BOOKS. 2,000 titles, all subjects! Free catalogue. Hamilton, 98-55 Clapboard, Danbury, CT 06810

"TROPICA"—Cyclopedia of Exotic Plants, 7,000 color photos, 1,136 pages, $115. Request circular. Roehrs, Box 125, E. Rutherford, NJ 07073

Collector's Items

RECEIVE VALUABLE MINERALS MONTHLY! Write today! Free Details! Mineral of the Month Club, 13057-H24 California, Yucaipa, CA 92399

Correspondence

MAKE FRIENDS WORLDWIDE through international correspondence. Illustrated brochure free! Hermes-Verlag, Box 110660/NH, D-1000 Berlin 11, West Germany

ORIENTAL WOMEN SEEK CORRESPONDENCE for cultural exchange, language practice, friendship. Asian Exchange, Honokaa, Hawaii 96727

Education

EXPLORE MICROSCOPIC WORLD—algae, protozoans, blood cells, etc. New Science Course for all ages. How to purchase and use a microscope with free brochure. Life Sciences, Box 591V, Woodbury, NJ 08096

FARRAGUT NAVAL ACADEMIES

A complete academic program: Oceanography, Naval Science, extracurricular activities, sports. Grades 5-12. Separate lower school. Small classes. Honor Naval School. Fully Accredited. Band. Riflery. Sailing. NJROTC. College guidance program. 2 waterfront locations. Write for catalog. *Admits students of any race, color, national or ethnic origin.*

NORTH: Box Z, Toms River, NJ 08753—201 • 349-1121
SOUTH: Box Z, St. Petersburg, FL 33710—813 • 384-5500

Employment Opportunites

AUSTRALIA NEEDS YOU! Jobs! Paid Transportation! Newest handbook, $2.00 (guaranteed). Australian International Services, Box 19107-RV, Washington, DC 20036

AUSTRALIA—NEW ZEALAND NEED YOU! Big Pay! 50,000 jobs. Free transportation. Latest listings $2.00. Austco, Box 772, Cypress, CA 90630

FREE DETAILS—OVERSEAS JOBS! All occupations! 68 countries. Paid fare. Computerized reports. Job world, Box 681, Cypress, CA 90630

OVERSEAS—ALL OCCUPATIONS! Worldwide Directory and complete information—$3.00. International Opportunites, Box 19107-RV, Washington, DC 20036

ROCKY MOUNTAIN EMPLOYMENT NEWSLETTER! Colorado, Idaho, Montana, Wyoming! Current openings—all occupations! Free details . . . Intermountain 4Y, 3506 Birch, Cheyenne, WY 82001

Foreign Newspapers

WORLDWIDE ENGLISH NEWSPAPERS. 65 countries including Malta! Sampler: 5/$2.98. Free Brochure. Multinewspapers, Box DE-206, Dana Point, CA 92629

Gourmet Interests

COUNTRY KITCHEN COOKING—Delicious & Economical Recipes. Main Dishes, Soup, Tamalies, Desserts, etc. Send $3.50 M. Kiriluk, Box 134, Tuolumne, California 95379

EXCEPTIONAL PICKLE RECIPES. Grandmother's Favorite Selection. $3 and SASE. French Creek Farm, Box 297, Buffalo, WY 82834

FANTASTIC SOUPS! Palate pleasing. Home Kitchen Tested. 5 gourmet Easy recipes. Hot and cold. $2.00 SASE CC, 10113 Joershke Dr., Suite 193, Grass Valley, CA 95945.

Government Surplus

"GOVERNMENT SURPLUS DIRECTORY." Buy 500,000 items (including Jeeps) . . . low as 2¢ on dollar! Most complete information available-$2.00. Disposal, Box 19107-RV, Washington, DC 20036

JEEPS—$58.00!—CARS—$35.00!—700,000 Items! Government Surplus—Most Comprehensive Directory Available Tells How, Where To Buy—Your Area—$2—Moneyback Guarantee—"Surplus Information Services", Box 99249-DC8, San Francisco, California 94109

Merchandise

BRIDGECLOTH SETS 54" square with 6 napkins. White with hand appliqued flowers. Specify green, yellow, pink, blue. $39.95 ppd. Money Back Guarantee. Check, Visa, Mastercharge. CC, 10113 Joerschke Dr., Suite # 193, Grass Valley, CA 95945.

NEW CO. offers Full color serigraph designs on fabric. Wall prints & T-shirts. Mexican dance masks, Orchids & Wild life. Free Brochure Emil Enterprise, P.O. Box 1532, San Luis Obispo, CA 93401

ORNATE ITALIAN LEVER CORKSCREW with matching nut cracker. The perfect gift. Only $14.95 ppd. Tri-Ped Ind., P.O. Box 419, Medford, NY 11763



I'm Wild About Life ©
This nature loving tote is 15 x 17 beige canvas with brown silk screen lettering. Strap fits over arm or shoulder. Ideal for any safari.
Peri Winkle Print
P.O. Box 269
Bohemia, N.Y. 11716
$ 9.95
Postage
$ 1.50

Miscellaneous

BECOME SELF-SUFFICIENT. Food production, storage, family preparedness. $6.00 for detailed program. AEI Corporation, Box 107(D), Nappanee, IN 46550. Phone (291) 773-2673

PANNING GOLD. Easy step by step instruction booklet. Explaining and illustrating what, where and how to pan gold. Send $5.00 M.O. to D.C. Chaves, Box 1039, Jamestown, CA 95327

Music

RECORDS-TAPES! Discounts to 73%. All labels; no purchase obligations; newsletter; discount dividend certificates. 100% guarantees. Free details. Discount Music Club, 650 Main Street, P.O. Box 2000, Dept. 25-0881, New Rochelle, NY 10801

Old Time Radio

OLD TIME RADIO PROGRAMS on cassette tapes. Free catalogue. Cassette Library Center, P.O. Box 5331H, Baltimore, MD 21209

Optics

BINOCULAR SALES AND SERVICE. Repairing binoculars since 1923. Alignment performed on our U.S. Navy collimator. Free catalogue and our article "Know Your Binoculars," published in Audubon Magazine. Mirakel Optical Co., Inc., 331 Mansion St., West Coxsackie, NY 12192 (518) 731-2610

LEITZ, ZEISS, B&L, SWIFT, BUSHNELL, NIKON. Optolyth binoculars, telescopes and accessories. Send stamp for discount list. Specify literature desired. Large stock. Orders filled postpaid day received. Birding, Box 5N, Amsterdam, NY 12010

OPTIC DISCOUNTS: Binoculars—Telescopes—Brand Names—Free Catalogue. Thos. Manetta, 61 Hoffman Avenue, Elmont, NY 11003

Photography

CLOSE-UP PHOTOGRAPHY IS MUCH EASIER now with slide rule calculator, The Macro Factor. Gives exact subject-flash distance without using formulas, charts, or computations—to 9x. $10.95 post-paid Photographic Reflections, Box 13018 (NH), St. Louis, MO 63119

NASA SPACE PHOTOS. Beautiful! Guaranteed. Free color catalogue. Woodstock Products, P.O. Box 2519-NH, Beverly Hills, CA 90213.

THE FLYING EAGLE®: Finest laser color reproductions of the ultimate Bald Eagle photograph. 16 x 20 Fine Art Print, $20. Kenneth R. Hunter, Ph.D., Egegik, Alaska 99579

Real Estate

NEW! FREE! Big Fall-Holiday Catalogue! Over 5,400 country properties described, pictured! Land, Farms, Homes, Businesses, Waterfront, Recreation, Retirement buys! Selected best thruout the U.S. Over 700 offices, 43 states. All Across America! Yours Free from the World's Largest! Strout Realty, Inc., 60 E. 42nd Street, Dept. 5390, New York, NY 10017.

FREE . . . 296-PAGE CATALOGUE. Describes and pictures over 2,800 farms, ranches, acreages, businesses and town and country homes from coast to coast. United Farm Agency, Inc., 612-V W. 47th St., Kansas City, MO 64112. Ph. Toll-Free: 1-800-821-2599; MO. Res. Ph. Toll-Free: 1-800-892-5785

GOVERNMENT LANDS. . . FROM $7.50/ACRE! Homesites, farming, vacationing, investment! "Land Buyer's Guide" plus nationwide listings—$2.00. Lands, Box 19107-RV, Washington, DC 20036

HOME BUYERS. Determine 101 factors about prospective homes. Carefully researched evaluation list. $5. Abrahams, Box 475N, Fayetteville, NY 13066

Resorts

ACADIA NATIONAL PARK, efficiencies, small apartments, daily or weekly off-season rates, AAA, write Cadillac Inn, Bar Harbor, Maine 04609

TOBAGO, PRIVATE BEACH COTTAGES on working cocoa plantation. Swimming, snorkeling, fishing from your front door. Bird watcher's paradise. Brochure. Charles A. Turpin, Charlotteville, Tobago, West Indies

VACATION/RELAXATION—Birdwatcher's delight—Peaceful, secluded nature lover's mountain retreat. Cave Creek Ranch, Portal, Arizona 85632

Tours/Trips

ADVENTURE TRAVEL: Tanzania Camping Safaris, Peru natural history, Himalayan Treks, Australian Adventures. Special birdwatching and natural history departures. Overseas Adventure Travel, 1430 Mass. Ave. # 303N, Cambridge, MA 02138 (617) 876-0533



Tibetan monk in Darjeeling bazaar — Doranne Jacobson

ADVENTURES—Photograph polar bears in the Arctic during October, touch a Whale in the breeding lagoons during February, sail among Humpback whales in Hawaii. Trips specializing in natural history with expert leaders to Tanzania, Kenya, Botswana, Rwanda and Zaire. Also Australia, Nepal, Sri Lanka, Ecuador and more. Unique expeditions to see endangered species—mountain gorillas, blue whales, Indian rhino and rare birds. New 1981-1982 trip preview available. Adventures International, 4421-N Albert St., Oakland, CA 94619

AFRICA. Spectacular birdlife and big game on 22-day safari visiting the Okavango Delta, the Namib Desert and Etosha National Park, commencing Francistown on Oct. 5, terminating Windhoek Oct. 26, 1981. $2795.00. Details from Camera Safaris, 34 Glencove Road, Greenvale, NY 11548.

DISCOVER BAJA! Join professional naturalists & crew for ocean going exploration of Baja's wilderness islands and lagoons. Gray whales up close, elephant seals, superb birding & lots more! Excellent photo opportunities, small groups. Color brochure. Pacific Adventures Charter Service, 2445 Morena Blvd., Suite 200H, San Diego, CA 92110.

GALAPAGOS HIKING AND SAILING EXPEDITIONS. Small groups. 1982 dates: February 4, April 22, July 7, August 4. Charters. Machu Picchu options and Chili ski options. Inca Floats, 5982N Balboa, Oakland, CA 94611 (415) 339-9095.

HIMALAYAN TRAVEL, INC. Trekking expeditions in the Everest and Annapurna areas of Nepal. Exotic cultures/spectacular mountain scenery. Box 481-NH, Greenwich, CT 06830 Toll Free (800) 243-5330

NEW ZEALAND WALKABOUT: A selection of escorted nature and hiking tours, featuring New Zealand's scenic National Parks, the Milford Track, Farm Holiday Stay. Pacific Exploration Company, Box 3042-N, Santa Barbara, California 93105

SAILING SCHOOL-SEASON 1981-1982. Seamanship and Navigation courses aboard 50' ketch 'Palisander'-Chesapeake Bay and Caribbean, also Blue Water Passages between. Cuttyhunk Marine Adventures, Gwynn, VA 23066

SAVE 50% ON CRUISES. Our members do. You can too. Details free. TravLtips Association, Box 188B5, Flushing, NY 11358

SCOTTISH HIGHLANDS. Wildlife trips weekly April-October. Other wildlife destinations include Shetland, Orkney, Iceland, Tanzania, Canary Islands, Nepal, Texas, Arizona & California, and Alaska. Also backpacking and trekking in Nepal, Peru, Bhutan and Scottish Highlands. Expert leadership. Write: McGregor Travel, 33 Lewis Street, Greenwich, Connecticut 06830, or call: (800) 243-5330.

SERENGETI: MIGRATION OF WILDEBEEST. 1982 departures. Send for details. Overseas Adventure Travel, 1430 Mass. Ave. # 303N, Cambridge, MA 02138 (617) 876-0533

RATE AND STYLE INFORMATION

$1.75 per word: 16 word ($28) minimum. *Display classified* is $150 per inch. All advertisements must be prepaid. Rates are not structured for agency or frequency discounts. All advertisements are accepted at NATURAL HISTORY's discretion. Send check/money order payable to NATURAL HISTORY Magazine, Central Park West at 79th St., New York, NY 10024. Please include your personal address and telephone number, issue preferred, and suggested heading. Deadline—8th of month, two months prior to cover date (the January issue closes Nov. 8). Camera-ready art is required for display ads. A tearsheet or copy of the page with your ad will be sent upon publication.

L.L.Bean®
Outdoor Sporting Specialties



FREE Fall Catalog

Fully illustrated. Features quality apparel and footwear for men, women and children; camping, hunting, hiking and winter sports equipment. For 69 years L. L. Bean has offered practical and functional merchandise at reasonable prices. Our clothing and footwear is rugged enough to withstand active outdoor use, yet attractively styled and comfortable for casual wear. Many items are of our own manufacture. All are guaranteed to be 100% satisfactory.

SEND FREE CATALOG

Name_____
Address _____
City _____
State_____ Zip_____

L. L. Bean, Inc.
741 Casco St., Freeport, ME 04033



At last—an efficient woodstove beautiful enough for your home

The WESO Ceramic Tile Stove enhances the beauty of the most tastefully decorated home, where a black metal heater would be rudely out of place.

You can see the flames flickering behind the wrought-iron style grille as the WESO — which employs both convection and radiant heat — surrounds you with gentle all-over warmth.

The WESO burns both wood and coal, holds a fire all night without tending, and offers every efficiency feature you could ask for. Now available in your choice of seven decorator tile colors.

Enclosed is $1. Rush me your literature showing the WESO CERAMIC TILE STOVE in all 7 tile colors — plus details about WESO's new COAL BURNING STOVE — and shipping schedule

Name _____
Address _____
_____ Zip _____

Ceramic Radiant Heat
2918 Pleasant Drive Lockmere, N.H. 03252

Celestial Events

by Thomas D. Nicholson

The Moon The early crescent moon shows up about the 2nd, and provides several interesting evenings as it moves toward Jupiter and Saturn on the 3rd and toward Spica on the 4th. It will be back in the same part of the sky from August 30 through September 1, when Venus is much closer to Jupiter. The late crescent moon passes below Mars in the morning sky of August 26. Phases in August are: first-quarter on the 7th, full on the 15th, last-quarter on the 22nd, new moon on the 29th; in September, first-quarter is on the 6th and full moon on the 13th. Apogee (farthest from the earth) is on August 8 and September 5; perigee (nearest the earth) is on August 21 and September 16.

Stars and Planets There will be seven planets in the evening sky: Mercury (after the 10th), Venus, Jupiter, Saturn, Uranus, Neptune, and Pluto. In the morning sky, there will be two: Mercury (until the 10th) and Mars. The sun moves from the constellation Cancer to Leo on the 10th; Mercury enters Leo in early August and Virgo late in the month; Venus moves out of Leo into Virgo on the 12th; Mars spends most of the month in Gemini but moves into Cancer on the 20th; Jupiter, Saturn, and Pluto are in Virgo; Uranus is in Libra; and Neptune is in Ophiuchus.

The best sky show this month is in the west just after sundown, where Jupiter, Saturn, and Venus are gathering just west (to the right) of Spica in Virgo. Watch from about half an hour after sunset until dark. Venus appears first—very low but very bright—followed by Jupiter, then Saturn and Spica. Early in the month Jupiter is close below Saturn, Spica is to their left, and Venus is about the same distance to their right and below them. During the month Jupiter separates slowly from Saturn, Venus moves rapidly toward them, and all three planets move toward Spica. By the end of August, Venus, Jupiter, and Saturn are lined up horizontally in the west and Venus has moved between Jupiter and Spica. The show will be especially interesting on August 2, 3, and 4, and again on August 30 and 31 and September 1, when the slim crescent moon is in the western sky after sundown.



Jupiter, Saturn, and Venus are prominent features of the evening sky all month in the constellation Virgo, midway between its brightest star, Spica, and Regulus, in Leo. In early August, Jupiter (the brighter) and Saturn are close, Venus is below to their right, setting earlier. By the end of August, all three are in the positions shown, half an hour past sunset, joined by the early crescent moon.

Helmut Wimmer

August 2: With a little luck, you can see the waxing crescent moon in the early twilight sky, brightly shining Venus is below it.

August 3–4: The moon is to the right of Jupiter and Saturn on the 3rd, to their left on the 4th.

August 9: The reddish star below the gibbous moon is Antares, in Scorpius.

August 10: Mercury is in superior conjunction, in line with the sun and earth but beyond the sun and entering the evening sky.

August 10–14: Look for the Perseid meteors any morning after 2:00 A.M. They will be best on the 12th, when you can see 50 or more shower meteors per hour, many of them bright, even bursting. Expect half as many on the mornings before and after this reliable shower, the most plentiful of the year for Northern Hemisphere viewers.

August 23: Mars, climbing sharply into the sky after rising before dawn, passes below Pollux and Castor, the "twin" stars of Gemini.

August 25–27: Venus passes below Saturn on the 25th, below Jupiter on the 27th, and then moves to the east (left) of both. The three planets will be exceptionally close to one another for several nights, but they set at about the end of evening twilight.

August 26: The waning crescent moon joins Mars, Pollux, and Castor in the morning sky. Look before dawn.

August 30–31, September 1: The early crescent moon passes above Saturn about 8:00 P.M., EST, on the 31st, above Jupiter five hours later, and above Venus during daylight on September 1.

September 6: Venus has been separating from Jupiter and Saturn, approaching the star Spica. This evening it passes above and moves to the left (east) of Spica. Jupiter and Saturn, to the right of Venus, set in the twilight.

September 10–13: Mercury, Venus, Jupiter, Saturn, and Pluto are all in the constellation Virgo, and the sun enters the constellation in a few more days.

September 13: Tonight's full moon is the harvest moon.

Editor's Note: The Celestial Events Sky Map in the July issue shows the evening constellations and stars for this month and gives the times for use.

"Rich...exciting...it's an adventure in itself."*

Over 300,000 Americans have tested their physical and emotional limits in the classic programs of Outward Bound. Now, *Outward Bound USA* tells the utterly unique history, philosophy, and lore behind this "aristocracy of service throughout the free world." (Sargent Shriver) "Rich in anecdotes and exciting...this book is also serious and important reading." —*William E. Simon

Illustrated with photographs

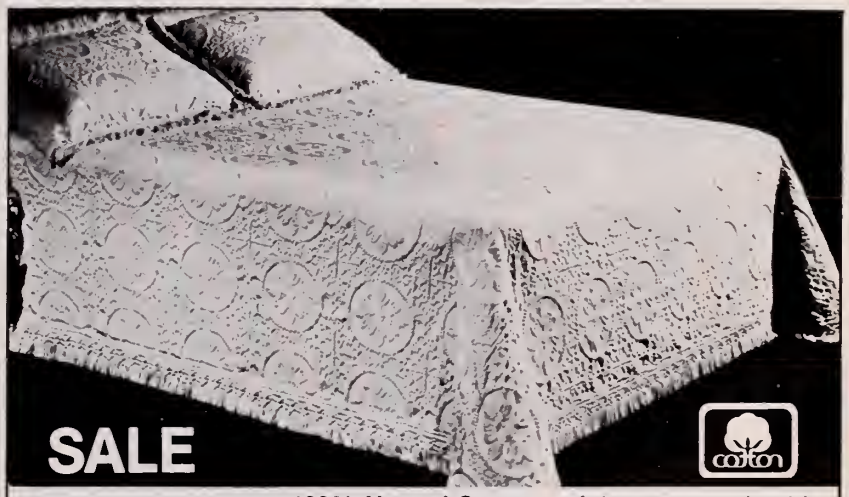


OUTWARD BOUND USA

Living Through Experience in Adventure-Based Education

by Joshua L. Miner *(First president of Outward Bound)* **& Joe Boldt**

$8.95 (Hardcover, $17.95)
A Morrow Quill Paperback
William Morrow
105 Madison Avenue, New York, N.Y. 10016



Beautiful Early American
"COLONIAL LOFT"
BEDSPREADS

- **Heavy—soft—durable**
- **100% Quality Cotton**
- **Machine washable**
- **Choose white or natural**
- **Special Prices:**

Twin 80 x 110, value $40..... only $29.95
Full 96 x 110, value $45..... only $35.95
Queen 102 x 120, value $55.... only $43.95
King 120 x 120, value $65..... only $49.95
Sham (standard), value $12 ..only $ 9.95 ea
Add $2.50 per order for shipping

100% Natural Cotton, soft but ever so durable. A true legacy of Early America. This elegant woven bedspread is fully pre-shrunk and machine washable, with no ironing ever. Rich, full, all-cotton decorator fringe. **Guaranteed.** We ship fast.

Homespun Crafts • Dept. NH-1, Box 1776* Blacksburg, S.C. 29702

Gentlemen: Please rush _____ "Colonial Loft"
_____ Size spreads & _____ shams, color: _____
☐ Check ☐ M.O. enclosed ☐ M.C. ☐ Visa
Credit Card No. _____ Exp. Dt. _____
Name _____
Address _____
City _____ State _____ Zip _____
M/C, VISA orders—call Toll Free: 800-458-3491, Ext. 82-G
CALL NOW!

Share the Thrills of Exploring Outer Space!



$359.95 f.o.b. Hartford, Conn.
$15 Crating Charge

Now it's easy to join the thousands of serious amateurs who have discovered the excitement of exploring our mysterious universe. Your enjoyment begins right from the start, yet the challenges and rewards go on for years! And it's a hobby that can be shared at modest cost.

Choose From Many DYNASCOPES®

Picking a telescope to fit your needs and your pocketbook is simple when you select a DYNASCOPE—the same instruments used by more than 150 schools, colleges and observatories—and your satisfaction is guaranteed by a full-refund warranty.

FASCINATING GUIDE YOURS FREE!

Read these valuable facts before buying any telescope. Mail coupon or postcard for your complimentary copy of this helpful guide.



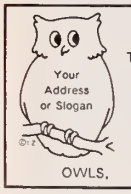
Criterion Manufacturing Co
620 Oakwood Ave., W Hartford, Conn 06110

® TM Registered U.S. Pat. Office

CRITERION MANUFACTURING CO., Dept NH 106
620 Oakwood Avenue., W Hartford, Conn 06110
Please send your free Telescope Guide.
Name_____
Address_____
City_____ State_____

AUTHORS WANTED BY NEW YORK PUBLISHER

Leading subsidy book publisher seeks manuscripts of all types: fiction, non-fiction, poetry, scholarly and juvenile works, etc. New authors welcomed. Send for free, illustrated 40-page brochure W-82 Vantage Press, 516 W. 34 St., New York, N.Y. 10001



OWL Stickers

This Sunny Yellow Owl, printed with your name & address or slogan, adds a little fun to letters, books, luggage, toys, promotions.....(shown half size)

Owl Shape...Self-Stick
100 for $6.50 or 200 for $9.20 ppd.

OWLS, Box 735-T, Acton, Mass. 01720



These perfect, golden pecans grow in our old family orchards in Georgia. We help them through the dry summers with modern irrigation, then hand pick the fanciest pecans and ship them to you, farm fresh. 2 lbs. shelled halves for $12.00 incl. UPS delivery. To order, call toll-free 800-251-6279* or write with check: The Forbes, Malatchie Farms, Box 100, Perry, GA 31069

NH10881C

*Visa, MasterCharge only

Representing Earth

by Richard Edes Harrison

THE MAPMAKERS, by John Noble Wilford. *Alfred A. Knopf, $20.00; 414 pp., illus.*

The Mapmakers is a comprehensive account of man's attempts to measure and depict our surroundings throughout the ages. The author has tackled this very complex subject successfully, but it should be said at the outset that the book concerns itself more with measurement (surveying) than with depiction (mapping). And it is not until one is halfway through this 200,000-word book that a clear distinction is made between the two. As a practicing cartographer for fifty years, I do not object, however, because in this case surveying is certainly the horse that is dragging the cart. The title, however, is misleading, and my guess is that the publisher figured it would be easier to sell a book about maps than one about surveying. He may be right, but to many readers, any work in the field—on land, on the seas, in the sky, or in interstellar space—is far more interesting than work on a drafting table, especially now that the drafting table is threatened with displacement by computers. So let us say that this is a book about surveying because surveying is still going strong.

Land measurement today involves the use of a bewildering array of instruments, but primitive humans had only their eyes to see with and their legs to measure with. With the acquisition of a measuring stick, mankind was on the way to sophistication. Many early cultures, such as the Chinese and the Maya, speculated about the earth, the sun, and the universe, but it was the Greeks who were on the right track. In the sixth century B.C., Pythagoras maintained that the earth was a sphere and his contemporary Thales actually predicted an eclipse of the sun. Two hundred years later, influential men such as Plato and Aristotle established the sphericity of the earth by direct observations: for example, of departing ships that seemed to sink below the horizon instead of getting smaller to the point of disappearance, of the curve of the moon's or Earth's shadow during eclipses, and of the new stars that came into view as one traveled south.

In the second century A.D. Claudius Ptolemy of Alexandria wrote two books, *Almagest* (on astronomy) and *Geography.* These were extremely useful as a collation of existing knowledge on these subjects, but in the process the author made two errors that persisted in damaging his reputation forever. First, he rejected the astronomer Aristarchus's proposal that Earth rotated about the sun in favor of Aristotle's Earth-centered universe, and second, he rejected Eratosthenes' measurement of Earth in favor of a much too small estimate by Poseidonius. He did, however, postulate many rules useful to later surveyors and cartographers. For example, he insisted that all maps have a grid, he invented the term *meridian,* and he recommended dividing the latitudes and longitudes into degrees instead of fractions, for which we are all grateful. He defined the scope of maps accurately and said they should be "in just proportion," that is, in scale. At this point the author interpolates a short discussion of scale that requires emendation. I quote: "Sometimes, particularly on road maps, scale is explained with a small ruler near the bottom of the map. This is a graphic scale." A graphic scale, also called a linear scale, is not used just "sometimes"; it is an absolute essential for

any scalable (that is, most median-scale and all large-scale maps) map because it provides the only direct method for making measurements on the map and it is the only form of scale expression that remains true upon reduction or enlargement of the map.

The chapter on Ptolemy is about one of the great keys to cartographic history and its conclusion is appropriate reading for these times.

> If Ptolemy's errors were many, often due to lack of reliable information, the maps based on his scholarship were the culminating achievement of ancient cartography and a crucial legacy. . . . More than a century after Ptolemy, Alexandria became a battleground of revolt and the museum buildings, now over 500 years old, were destroyed. The temple housing the library survived and a few scholars sought to carry on the museum's tradition of research. Finally in 391 A.D., Christian mobs sacked the library, burned the priceless contents and converted the shell into a church. It was a symbolic victory of faith over reason. The words of Claudius Ptolemy, among others, were lost to the Western world for more than a millennium and so too his ideas and ideals for a scientific cartography.

The author then carries us through the Dark Ages, dwelling perhaps a little too extensively on the ignorance, the meaningless mythology and suppression of curiosity while the accumulated wisdom of the Greeks was imprisoned in a few monasteries. The growing waterborne commerce prompted a new start toward exploring the unknown, and by the beginning of the fifteenth century, Henry the Navigator, prince of Portugal, formed the beginnings of a shore-based organization devoted to stimulating exploration and studying the results. Maps are mentioned frequently, but there is relatively little in-



SEMINARS IN ORNITHOLOGY

The Laboratory of Ornithology at Cornell University Offers a Home Study Course in Bird Biology

Inquire: NH, 159 Sapsucker Woods Road, Ithaca, NY 14850



THE MUSEUM SHOP

For your holiday gift giving, remember the Museum Shop. You can visit us or mail this coupon for a new fall catalog.

American Museum of Natural History
Museum Shop Catalog, Department NH
CPW at 79th St.
New York, N.Y. 10024

Name _____

Address _____

City _____

State _____ Zip _____

Speak German like a Diplomat!

What sort of people need to learn a foreign language as quickly and effectively as possible? Foreign service personnel, that's who.

Now *you* can make a start on learning to speak German with the same materials used by the U.S. Department of State — the Foreign Service Institute's *Programmed Introduction to German* and *Basic Course, Continued*

The FSI spent thousands of dollars and many years developing these materials for use by members of America's diplomatic corps. Today people in all walks of life who need to learn to speak a foreign language are turning to this outstanding audio cassette program.

The Foreign Service Institute's German Course is by far the most effective way to learn German at your convenience and at your own pace. It consists of a series of tape cassettes and accompanying textbook. You simply follow the spoken and written instructions, listening and learning. By the end of the course you'll find yourself learning and speaking entirely in German! A native German speaker, clearly recorded on the cassettes, provides an excellent model to help you develop your skills.

This course turns your cassette player into a "teaching machine." With its unique "programmed" learning method, you set your own pace testing yourself, correcting errors, reinforcing accurate responses.

The FSI's Programmed German Course comes in two volumes: You may order one or both courses.

☐ **Volume I. Programmed introduction to German,** 9 cassettes, 12 hours and 647-page text, $115

☐ **Volume II. Basic Course, Continued** 8 cassettes, 8½ hours and a 333-page text, $98

(New York State residents add appropriate sales tax.)

Your cassettes are shipped to you in handsome library binders.

TO ORDER, JUST CLIP THIS AD and mail with your name and address, and a check or money order. Or charge to your credit card (American Express, VISA, Master Charge, Diners Club) by enclosing card number, expiration date, and your signature.

The Foreign Service Institute's German course is unconditionally guaranteed. Try it for three weeks. If you're not convinced it's the most convenient and most painless way to learn German, return it and we'll refund every penny you paid! Order today!

Audio Forum
Dept. K-12
145 East 49th St.
New York, N.Y. 10017
(212) 753-1783



AUDIO-FORUM®

BOOK HUNTING?

Virtually any book located—no matter how old or long out-of-print. Fiction, nonfiction. All authors, subjects. Name the book—we'll find it! (Title alone is sufficient.) Inquire, please. Write: Dept. 71

BOOKS-ON-FILE P.O. BOX 195
UNION CITY, NEW JERSEY 07087

Fish & Wildlife T-SHIRTS

Killer Whales, Dolphins, Largemouth Bass, Smallmouth Bass, Shark, Nautilus Shell, Tiger, Eagle, Horses, Brook Trout, Catfish, Wolf, Panda, Blue Gill, Striped Bass, Starfish, Penguins, Rainbow Trout, Bluefish, Red Salmon, Blue Marlin, Blowfish, Sea Horse, Red Snapper, Crappie, Northern Pike, others

White Cotton T's with color silkscreen print

Specify: S, M, L, X-L Brochure $1.00
$7.00 ea. 4 $25.00

STREAMERS • P.O. Box 6946-H
Providence, RI 02940

PERU

CUSCO — MACHU PICCHU
THE AMAZON

The largest variety of tour packages including First Class and Delux hotels, at the lowest price ever.

CALL NOW — TOLL FREE 1-800-223-1367
IN N.Y. CALL COLLECT (212) 582-7811
VALISHA TRAVEL
250 W. 57th. St.
N.Y.C. 10019

OST CRAVATS

OST Cravats Inc., Dept.G1
502 West Lantana Road
Lantana, Florida 33462
(305) 586-3322

FREE 24 page color catalog of new and traditional neckwear in Open Collar and Four in Hand styles. Fine imported silks and polyester meticulously tailored at prices not available at retail. Just mail coupon or phone for the only catalog of its kind in the world. **FREE**

We also design and make CORPORATE TIES to order. Enquiries invited • 150 minimum.

WHEN YOU WRITE TO NATURAL HISTORY

about a subscription renewal, billing, or any kind of adjustment, please include your present address label.

Moving? Please notify 6 weeks in advance. Send your present address label along with your new address to Natural History Membership Services, Box 4300, Bergenfield, NJ 07621

Name

New Address

City State ZIP
Please Print **Attach Label**

formation about their actual drafting or who drew them. I suspect that in the early days drafting was usually done by the skipper, but later on it might have been done by a bright midshipman. And of course the voyager might bring home sketches and notations that a professional would then convert to a map. These gentlemen and their products are not neglected; we learn about Abraham Cresques, Martin Behaim, Gerhard Mercator (plenty about him), Martin Waldseemüller, and the Cassinis—father, son, grandson, great-grandson, and many others.

We also learn about the invention and development of triangulation, the measurement of arcs of meridians (to reveal the true shape of the globe), and the origins of the compass, astrolabe, sextant, theodolite, transit, and a host of other instruments. John Harrison's invention of the chronometer (thereby solving the problem of measurements of longitude at sea) is a particularly fascinating story. In the eighteenth century, in 1779, the Cassinis completed the mapping, by triangulation, of France. In the United States the heroes of surveying and mapping were Mason and Dixon, Lewis and Clark, Powell, Maury, and Ewing.

The first half of the book ends with the international agreement to collaborate on a "one-millionth" (sixteen miles to the inch) map of the world. The second half is devoted to the twentieth century and the astounding inventions that have revolutionized surveying and mapping. These include the airplane, specialized cameras, deep-sea drilling, bathyscaphs, lasers, tellurometers, sonar, radar, satellites, and automated surveying and mapping. This is exciting stuff and well told. Wilford had an enormous amount of homework to do and mastered it handsomely. The only weak spot to my eye is the four-page section on map projections. It lacks organization and misses the interrelations of projections entirely, but it is accurate as far as it goes.

Each of the four sections of *The Mapmakers* is preceded by a short episode of a recent expedition that surveyed the Grand Canyon with the latest gadgetry, including helicopters, walkie-talkies, and a distance-measuring instrument loaded with telescopes, laser beam generators, computers, and so on—price, $18,000. The author was present on this trip as a modern reincarnation of a "chain carrier" (surveyor's assistant), and the experience no doubt intensified his urge to write this book.

He writes appreciatively about François E. Matthes, of the U.S. Geological Survey, who surveyed the canyon eighty years ago. "He did it by plane table and transit, by foot and mule, by patience and fortitude." After the leader of the recent expedition, Bradford Washburn, an accomplished mountaineer and explorer, had completed his calculations one day, he remarked, "It is surprising how closely the new data agrees with the older surveys of the Grand Canyon." The helicopters and the distance finder certainly saved an enormous amount of hard work and time in this survey, but I am sure that the innovators will not be satisfied with this. The next development may be a completely automated surveying and mapping plant on an airplane, which will deliver finished and printed maps upon landing. In this scheme two important things will be lost, the pride of workmanship and the role of judgment in map design. This is sometimes called Art and is unknown to computers and most engineers. Will we be smart enough to avoid this pitfall?

The above review was written on the basis of an advance copy consisting of bound page proofs, without an index, illustrations, bibliography, or notes. A bound copy arrived too late to make changes but the following information may be useful. The book now has fourteen pages of bibliography and lists of persons interviewed arranged by chapters—a most impressive feature. There are a good many illustrations, intelligently selected but surprisingly uneven in quality. For example, a Landsat photomosaic of New Jersey is sharp and clear, but the Landsat photomosaic of the entire United States is murky and almost unreadable. The first picture in the book, however, is a stunner of the author and a surveyor on top of an extremely perilous pinnacle in Grand Canyon. Makes me shiver.

There is one rather embarrassing error: on page 299 it is reported that geologist Bruce Heezen received the Buchler Medal from "The American Geographic Union." On a hunch, I called the American Geophysical Union in Washington, and it is indeed this group that awarded Heezen this richly deserved medal.

Richard Edes Harrison, who has been described as an "explanatory" cartographer, is the first and only holder of the O.M. Miller Medal for Cartography and Geodesy awarded by the American Geographical Society in 1968.



Pentax binoculars separate the bird from the bush.

A Bittern sits motionless, challenging you to pick him out from a background that seems to match him perfectly. Now you need the razor sharp optics, high contrast and superb color rendition of Pentax 8x30 Lightweight Binoculars. Fully coated, perfectly matched optics, fold-over eyecups for eyeglass wearers. Lifetime warranty. See the difference at sporting goods dealers or write Pentax Corporation, Englewood, CO 80112.

PENTAX BINOCULARS



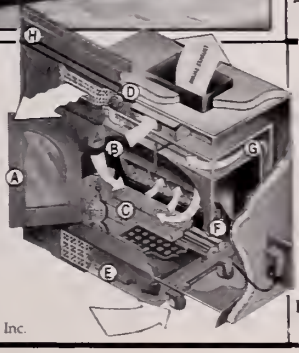
Save Your Fireplace!

Those crackling flames can lift your spirits, but your open fireplace actually *wastes* more heat than it delivers. Perhaps you've discovered that tubular grates, glass doors and ordinary fireplace inserts offer only a partial solution at best. Yet a black metal woodstove on your hearth would be an affront to your room decor.

Efficiency on wheels

The Shelburne can transform your fireplace into a super-efficient heat producer without compromising the visual and soul-warming pleasures it provides. You enjoy a visible fire behind safe Corning Pyroceram glass. Downdraft combustion, 2000°F space-capsule insulation and a 40" baffle system help account for its amazing performance. And the Shelburne *rolls out* on your hearth for easy chimney cleaning.

The Shelburne Fireplace-Stove



(A) Doors may be opened to view the fire (B) Air is preheated as it enters downdraft and secondary air tubes (C) Firebrick-lined ¼" steel firebox (D) Automatic thermostat (E) Pullout ash pan (F) Fan with speed control (G) 40" baffling system (H) Flanges in choice of 3 widths permit installation in over 80% of all fireplaces.

Patents pending
© 1981 Vermont Stove Co., Inc.

☐ Rush me your Information Portfolio including complete details on the new Shelburne Fireplace-Stove, insulation sample swatch, and direct-from-manufacturer prices. Enclosed is $1 to help cover mailing costs

Name _____

Address _____

_____ Zip _____

The Vermont Stove Company
Dept. 2418, Route 7, Shelburne, Vt. 05482
(802) 985-2592

Additional Reading

Maya Volcanoes (p. 32)

Based on extensive field studies of many of the earth's important volcanoes and volcanic regions, F. Bullard's *Volcanoes of the Earth* (Austin: University of Texas Press, 1976) presents in nontechnical language current knowledge of volcanoes and their effects on the environment and people. This 579-page text, amply illustrated with photographs, diagrams, and maps, includes a full-color section showing volcanoes and volcanic eruptions in many parts of the world. A summary of the prehistory of Chalchuapa, a major site in the Maya frontier region, R.J. Sharer's "The Prehistory of the Southeastern Maya Periphery" (*Current Anthropology,* vol. 15, pp. 165–87) establishes a basic chronology for occupation at the site and defines the sources of external influences. Sharer also discusses changes in Chalchuapa brought about by the eruptions of Ilopango. "Chalchuapa: Investigations at a Highland Maya Ceremonial Center," also by Sharer (*Expedition,* Winter 1969, pp. 36–38), surveys some of the more significant results of the University Museum's archeological research at El Trapiche, northeast of Chalchuapa. P.D. Sheets's "An Ancient Natural Disaster" (*Expedition,* Fall 1971, pp. 24–31) reconstructs the nature and effects of the second-century Ilopango eruption, proposing that the thick layer of volcanic ash deposited over Chalchuapa rendered farm lands unusable and prompted the emigration of groups of Protoclassic peoples to new areas. Sheets and D.K. Grayson edited *Volcanic Activity and Human Ecology* (New York: Academic Press, 1979), a multidisciplinary collection of twenty articles exploring volcanic hazards and their adverse and beneficial effects on living organisms and the environment. This work includes a chapter by Sheets, enriched by a very useful bibliography, on the cultural and environmental effects of the Ilopango eruption on Central America (pp. 525–64). *Volcanism and the Prehistory of the Zapotitán Valley, El Salvador,* edited by Sheets, will include the work of about twenty authors and cover the volcanic eruptions of the last 2,000 years in central El Salvador. This archeological survey, scheduled to be published by the University of Texas Press, Austin, next year, will contain data from excavations at numerous sites in the Zapotitán Valley, including Cerén and Laguna Caldera. *The Environment as Hazard,* by I. Burton, R.W. Kates, and G.F. White (New York: Oxford University Press, 1978), is a multidisciplinary summation of the whole range of experience associated with natural disasters.

Avocets and Stilts (p. 42)

Even though the large, colorful avocet is a conspicuous, social bird with a wide distribution, it has received little ecological or behavioral study. One good account presenting information about avocet breeding biology, based on research done in the late sixties, is F. Gibson's "The Breeding Biology of the American Avocet (*Recurvirostra americana*) in Central Oregon" (*Condor,* vol. 73, pp. 444–54). Gibson, who observed avocets during three breeding seasons in an alkaline marsh, reports on the birds' territorial system, courtship, nest building, egg laying, incubation, and hatching. R.B. Hamilton's "Comparative Behavior of the American Avocet and the Black-necked Stilt (Recurvirostridae)" (*Ornithological Monographs* no. 17, published by the American Ornithologists' Union, 1975), a summary of the biology of this family that includes detailed descriptions of behavioral displays, is virtually the only published study of black-necked stilt breeding behavior. Hamilton concludes that the numerous morphological and behavioral differences between these two closely related species correlate with habitat differences and probably reflect differences in their evolutionary histories. *The Shorebirds of North America,* edited by G.D. Stout (New York: Viking Press, 1967), contains accounts of species by R.S. Palmer, a popular-style text by P. Matthiessen describing habits and histories of the birds, and excellent color plates from paintings by R.V. Clem. Another general text is A.C. Bent's *Life Histories of North American Shorebirds* (New York: Dover Press, 1962), originally published in 1927 and still a standard reference for avian life histories. Bent's text includes many fine descriptions of behavior, although as noted in the present account, he misinterprets avocet distraction behavior. Two books on predator–prey behavior are E. Curio's *The Ethology of Predation* (New York: Springer-Verlag, 1976), a technical review of the predatory and antipredatory behaviors of animals, and R. Meinertzhagen's *Pirates and Predators* (London: Oliver and Boyd, 1959), a colorful account of hunting behaviors of birds of prey around the world that typifies the "fang-and-claw" approach to biology. "Life at an Avocet Nest," with photographs by M.M. Tremaine (*Audubon,* March 1975, pp. 68–75), is a short, staff-written photographic essay providing basic information about avocets. One of the twelve locations described in *Roger Tory Peterson's Dozen Birding Hot Spots,* by G.H. Harrison (New York: Simon and Shuster, 1976), is the Bear River Wildlife Refuge, one of the two study areas discussed in this issue's article.

Narwhals (p. 50)

"Whether there is or is not an actual unicorn . . . he cannot possibly be so fascinating or so important as the things men have dreamed and thought and written about him," states O. Shepard in the introduction to *The Lore of the Unicorn* (Boston: George Allen and Unwin Ltd., 1978). Originally published in 1930, Shepard's eloquent, illustrated study traces the long history of the legend of the unicorn, beginning with its first appearance in Western literature in the fourth century A.D. Chapter nine, "Certainties" (pp. 253–72), outlines the discovery of the "sea unicorn," the narwhal, and the commercial history of its tusk. A large, informative volume that describes in detail thirty-three species, *The Book of Whales,* written and illustrated by R. Ellis (New York: Alfred A. Knopf, 1980), includes a chapter summarizing basic knowledge of narwhal biology, the effect on the whale of hunting, and whale mortality (pp. 95–100). An illus-

trated text comprising twenty-one comprehensive articles written for scientists and laymen, *Marine Mammals of Eastern North Pacific and Arctic Waters,* edited by D. Haley (Seattle: Pacific Search Press, 1978), contains M.A. Newman's "Narwhals" (pp. 138–44). Illustrated with more than two hundred photographs, F. Bruemmer's anecdotal, personal narrative *Encounters with Arctic Animals,* (New York: American Heritage Press, 1972), relates how they live, are hunted, and have been affected by humans. Bruemmer's informative chapter "The Sea Unicorn," on the narwhal and its closest cousin, the white whale, appears on pages 220 to 237.

Weeds (p. 58)

Although no books deal primarily with railroads as habitats for plants, E. Salisbury's *Weeds and Aliens* (London: Collins, 1961) provides an excellent, readable, and authoritative introduction to the natural history of weeds in all their major habitats. Focusing on the traits of weeds that make them successful colonizers, T.A. Hill's *The Biology of Weeds* (London: Arnold, 1977), number 79 of the Institute of Biology's "Studies in Biology" series, also reports the adverse impact weeds may have on crop plants. J. P. Grime's more technical study, *Plant Strategies and Vegetation Process* (New York: John Wiley and Sons, 1979), outlines the processes that control vegetational structure and composition and discusses the kinds of strategies that allow plants to colonize and flourish in different habitats. No mention is made of railroads specifically, but much attention is given to the special adaptations and evolutionary strategies of weeds. J. C. Kricher's "Needs of Weeds" (*Natural History,* December 1980, pp. 36–45) examines, from an ecological and evolutionary standpoint, the vital role of weeds as colonizers, their high dispersal rates, herculean reproductive powers, and adaptability to rigorous environments. The "Additional Reading" column of that issue (p. 74) describes ten more references.

Rita Campon

Sale! LAST TIME AT THIS PRICE!

Due to the soaring cost of GENUINE LEATHER, we cannot hold this price much longer Order now!

The World's Most Comfortable Shoe!



Genuine Leather

NOW! BLISSFUL COMFORT MORNING TO NIGHT! The closest thing to going barefoot! Handsomely-styled CosmoPedic shoes are the ultimate in comfort . . . and quality-crafted with features you'd expect to find in a $50 or $25 shoe! Luxurious genuine leather uppers in deer-tanned smooth or sueded leather are incredibly soft, yet amazingly shape-holding. The unique CosmoPedic arch support assures comfort thru long hours of standing or walking. A stitched collar prevents annoying chafing around the ankles. And for that walking-on-air feeling . . . cushioned insoles and crepe soles pamper your feet from heel to toe! In Tan or Black smooth leather. Brown or Sand sueded leather . . . just $14.88!



Smooth or Sueded

MEN'S SIZES
6½, 7, 7½, 8, 8½, 9, 9½, 10, 10½, 11, 11½, 12, also 13
WIDTHS: C, D, E, EE, EEE

WOMEN'S SIZES
5, 5½, 6, 6½, 7, 7½, 8, 8½, 9, 9½, 10; ALSO 11
WIDTHS: B, C, D, E, EE, EEE

FAMOUS 14 DAY COSMOPEDIC GUARANTEE

The Famous Deluxe CosmoPedic™

TRY THEM AT OUR RISK

OLD VILLAGE SHOP
Hanover, Pa. 17331

SATISFACTION GUARANTEED! MAIL TODAY!

OLD VILLAGE SHOP, Dept. VM-3500, 340 Poplar Street, Hanover, Pa. 17331

Sure, I'll try the world's most comfortable shoes. Please send me:

MEN'S SHOE
____ prs. Men's Tan Leather (M2425788) Size ____ Width ____
____ prs. Men's Black Leather (M2368028) Size ____ Width ____
____ prs. Men's Brown Sueded (M2425868) Size ____ Width ____
____ prs Men's Sand Sueded Leather (M233361B) Size ____ Width ____

WOMEN'S SHOE
____ prs. Women's Tan Leather (M2035628) Size ____ Width ____
____ prs. Women's Black Leather (M2036878) Size ____ Width ____
____ prs. Women's White Leather (M2236938) Size ____ Width ____
____ prs. Women's Brown Sueded (M2237848) Size ____ Width ____

for just $14.88 pr., plus $2.90 per pr. postage and handling.
SAVE MORE! Order TWO pair for just $28.99 plus $5.00 postage and handling.

CHARGE IT: ☐ American Express ☐ Carte Blanche ☐ Master Charge Interbank #_____
☐ VISA/BankAmericard ☐ Diners' Club

Enclosed is $_____ Acc't #_____ Date Exp._____

PRINT NAME _____

ADDRESS _____

CITY_____ STATE_____ ZIP_____

☐ Check here and send 50c for a year's subscription to our full-color catalog of fine gifts (VZ389965X). We ship within 48 hours! Any delays notified promptly Delivery guaranteed within 60 days.

© Old Village Shop 1981

The Nature Faker

Until her retirement last April, Frederica Leser worked on the top floor of the American Museum in a sunny, cluttered corner of the exhibition studios. She recently returned for a retirement tea, and as she sat at her desk, she talked about her experiences at the Museum. A handsome and direct woman with gray hair and a tanned face, Leser worked as an artist in the Exhibition Department for twenty-one years. Her specialty was painting, with great skill, casts of fishes, amphibians, and reptiles for exhibition halls. Using glazes, washes, metallic paints, lacquers, and oils, she re-created the silvery sheen of salmon, the neon colors of tropical fishes, the warm ochers of pythons and rattlesnakes, the azures and dusty greens of lizards, and the glossy blacks and reds of salamanders.

Leser began painting animal casts for the Hall of Ocean Life and then moved to the Hall of Reptiles and Amphibians. She also built models and prepared artificial leaves, grasses, and other odds and ends for dioramas and habitat groups. Her last major project was painting the murals, frescoes, and complex, interlocking designs in the new Hall of Asian Peoples.

"I did a couple of pythons and most of the other animals for the Hall of Reptiles and Amphibians," she explained. She rummaged through a pile of blown-up photographs and pulled out one that showed her hunched over the cast of an enormous snake coiled about a pile of eggs. "This python was cast live. She was anesthetized and coiled about these python eggs to show how she incubates. I painted every scale many times to build up the color through multiple glazes. If you've ever seen one of these things alive, you know what rich, deep colors they have. You can't just paint the thing once and have it look real. When you're nature-faking, you get a sense of just how beautiful these animals are. They're a tremendous challenge for an artist.

"The twenty-five-foot reticulated python in the hall was the first snake I did. We had an old mounted python that had been around for years, never painted or finished, looking just like a piece of dirty brown leather. When I started painting it, I made several trips to the zoo to get the colors exactly right. I remember one time I wanted to see the color of the belly, and someone brought out a little ten-foot python—they wouldn't let me see the big ones. I'm not afraid of snakes, and I got in very close, a little too close I suppose, and the zoo keepers shouted at me to 'get back!' Apparently these sluggish snakes have a simply dreadful bite, and they strike suddenly and very fast.

"The first big hall I did was the Hall of Ocean Life. I painted 85 to 90 percent of the fishes in the hall, mostly with an air brush. The reptiles require more exact brushwork because they have a precise, hard-edge quality to their coloring. Fishes are softer. They ranged from tiny fish the size of your thumb to the great white shark. Dave Schwendeman, who is the chief taxidermist in exhibition, positioned and cast most of the fishes from preserved specimens. It was Dave who taught me to "see" the animals I was trying to reproduce, to realize their subtlety.

"The colors of live fishes are very beautiful and deep—and difficult to capture in paint. We used a lot of pearlescence and washes and metallic paints to give them those special silvery and shining fish colors. Finding the exact colors to use was a problem. The color leaches out of preserved fish, although they keep their markings. You really need to look at live or freshly killed fishes, since they lose their color so fast. Some colors—I hate to admit it—we had to guess at. All we knew about the Chinese river fish was that they were the color of mud. As you know, mud comes in many colors—brown, red, black, gray, or whatever. We painted our fish brown. With the Chinese delegations touring the museum, we're just waiting to hear how the river fish are all the wrong color. We spent six or seven years painting the fishes in that hall.



Frederica Leser fixes a crocodile's teeth for the Hall of Reptiles and Amphibians



NATURAL HISTORY
Magazine

YES, send me 12 color-packed issues of NATURAL HISTORY Magazine, along with the bonus supplements, and make me a member of the American Museum of Natural History, giving me free admission and discounts at the gift shop, for just **$15.**

I realize I am always free to cancel at any time for any reason and receive a full refund for all the unmailed issues.

☐ I prefer to save by ordering 2 years for just **$26.**

Send bill to:

Name_____

Address_____

City_____

State_____ Zip_____

☐ New ☐ Renewal

Send gift to:

Name_____

Address_____

City_____

State_____ Zip_____

I prefer to give: ☐ 1 year at $15 ☐ 2 years at $26

Please allow 7 weeks for delivery of your first copy.
Outside U.S.A. add $2 per year for postage.

J443

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO. 30 BERGENFIELD, NJ

POSTAGE WILL BE PAID BY ADDRESSEE

NATURAL HISTORY

P.O. Box 4200
Bergenfield, N.J. 07621

"I started at the Museum in October of 1960. I'd been painting on my own for seven years after college, and I thought it was about time I got a steady job. So I came over here and by God they hired me.

"My first assignment was helping our taxidermist clean the birds in the Hall of North American Birds. We repaired the old mounts, cleaned and arranged the feathers, and I painted the bills and feet. Do you know how to clean a mounted bird? You wash it with unleaded gasoline, sprinkle it with plaster dust to absorb the dirt, and then blow off the plaster with an air hose. I also made 4,000 mangrove leaves. You know that mangrove swamp in the hall—I made all those damn leaves. I would never do that again.

"People ask me how I can have the patience to paint snakes, frogs, and so on. People aren't aware of the beauty of the colors of animals."

Scattered about Leser's desk, lying on tables, hanging on walls, and piled on the floor are many odd things, either artifacts of past projects or bits and pieces of projects under way. Stuck into a block of styrofoam are seven fake dandelion leaves that look perfectly real as close as six inches away. Perched on top of a cabinet is a scruffy hawk missing numerous tail feathers. ("The Ornithology Department wanted to throw it away. We *never* throw anything away around here.") Hanging on a large pegboard are some fifty plaster animal muzzles, one crocodile face, two gorilla feet, one tapir nose, and a fish. ("Somebody wanted to throw these out too. Can you imagine?") Twenty feet from the desk is an osprey nest: a mass of sticks, eelgrass, seaweed, and crab shells hung on a branch. ("Dave renovated the nest and I went to Montauk and collected a baleful of fresh nest material. There were two ospreys, but one disappeared years ago.")

She opened a small cabinet and removed some unpainted casts. "This is a flying lizard from Madagascar or someplace like that. Like a moth, it's attracted to light and it flies into people's

DISCOVERY TOUR TO THE NILE



American Museum of Natural History
Discovery Tours

Discover the world of ancient and modern Egypt on an American Museum 600 mile Nile Cruise. Explore with three lecturers the rich natural and archeological sites of an area which has fascinated visitors for centuries... A carefully planned itinerary (with a special two-day program in London visiting the British Museum with its keeper) provides a relaxing and thorough three-week Discovery Tour. All of the major Nile archeological sites as well as the important wildlife regions are discussed and visited with your balanced team of eminent lecturers. Share with Museum staff and friends an unforgettable cruise. February 9-25, 1982. For further information and itineraries write to the **American Museum of Natural History, Discovery Tours,** Central Park West at 79 St., NY NY 10024, or call (212) 873-1440.

NATURAL HISTORY MAGAZINE BINDER



The functional way to save your full year's issues for future reference and pleasure. "Natural History" stamped in gold color on dark green leatherette over heavy binder's board. 12¾" x 9". Price $6.50. Members $5.85.

American Museum of Natural History
Museum Shop
Dept. 229
CPW at 79th St.
N.Y., N.Y., 10024

Qty	Price	Shipping/ Handling	Total
		$2.00 ea.	
		Order Total	
		N.Y. Sales Tax	
		Total Amount	

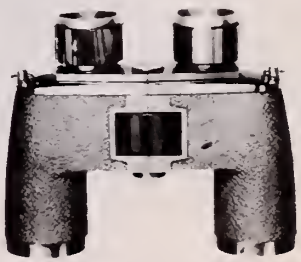
Enclosed is check/money order for $ _____

Name _____

Address _____

City _____ State _____ Zip _____





BUSHNELL 7x35 CUSTOM
Mfg. List $280.00 **Postpaid $164.00**
This is an example of the deep discount prices on high quality optics that is found in our FREE catalog. This catalog lists and illustrates an outstanding selection of telescopes, binoculars etc., plus valuable information on how to properly select them. Write for it today.

GIL HEBARD OPTICS
COURTHOUSE SQ., KNOXVILLE, ILL. 61448

Come explore a comet.

Halley's Comet returns in 1985. The Europeans, the Soviets, and the Japanese are readying spacecraft to meet it. Our nation plans to watch from afar because NASA has no money for a Halley mission even though only the U. S. has the technology needed to fully probe this comet for the clues it offers on



the origin of our solar system. We stand to lose not only knowledge, but also new technologies and a bit of our prestige.

Last year 10,000 people used the Viking Fund to show their support for space exploration. They contributed an average of $10 apiece to help one starving project: the Viking lander on Mars.

Now the Viking Fund's organizers announce the Halley Fund. By donating to this new fund, you'll let Washington know you want a U. S. probe of this comet. Your money will help pay for the mission, for Halley studies from the shuttle, and for U. S. participation in the International Halley Watch.

So come explore a comet, but don't delay. Your next chance to contribute to a Halley fund won't come until the year 2062.



THE HALLEY FUND

Dept. NH
3033 Moorpark Avenue, Suite 27
San Jose, CA 95128

I want to help pay the cost of U.S. studies of Halley's Comet.

Name

Address

City State Zip

(Donations tax deductible)

windows at night. Imagine sitting in your living room and having this thing fly in."

Leser was asked about her plans for the future.

"I have a few acres on Long Island," she said, "and I'm trying to get a variance to build a small earth-sheltered solar house using native materials. I'll also get back to my painting, and I'm going to take a raft trip down the Colorado River. I'm interested in all kinds of things."

On her way out, Leser passed a reconstruction of the extinct dodo bird and stopped. "It's being repaired with pigeon feathers," she said. "I love its expression and its purple face. They don't really know the color, of course.

"Working in the Museum has been a wonderful experience. I love the Museum very much; as an entity in itself, as a great museum, and as a repository of incredible collections, it is just fantastic."

Douglas J. Preston

Indonesian Odyssey

During the past decade the richness of Indonesia's natural history and ancient cultural traditions have attracted an increasing number of travelers. The Museum is pleased to offer its members and friends a custom-designed tour that will include the highlights of Indonesia as well as numerous ports and excursions not available on the standard tours usually offered to the public. The *Indonesian Odyssey,* February 21 to March 13, 1982, is based on the Museum's long tradition of expeditions to this remote and beautiful archipelago.

Thomas D. Nicholson, director of the Museum, will head a traveling faculty of five lecturers for the voyage. An anthropologist–art historian, an astronomer, a geologist, a herpetologist, and an ornithologist will provide participants with an in-depth lecture program about this exciting area.

Highlights of the trip include a visit to the Sultan's Palace on Java; a cruise to the islands of Flores, Mai, and Banda to see ceremonies and experience the lush tropical landscape studded with smoking volcanoes; a visit to Komodo Island to study the Komodo dragon; and a stop at Bali, where the late Margaret Mead did much of her research.

The Museum's ship is the m.s. *Regina,* renovated in 1980. Its facilities include three lounges, a gymnasium, a swimming pool and sauna, and ample deck space for sunbathing and reading.

For further information about this tour and other Museum tours, write to Discovery Tours at the Museum or call (212) 873-1440.

Shakespeare Summerfest

The Museum is planning a number of activities in conjunction with the special exhibition in Gallery 3, *Shakespeare: The Globe and the World.* All programs taking place in the Museum are listed here; for other Summerfest Programs, write to the Education Department for a brochure or call the Museum at (212) 873-1300, ext. 227. All programs listed below are free.

Shakespearean Tours and Lectures

Brief talks will be given several times a day in the exhibition, and guides will be available to answer questions. Three longer lectures will also be given every day in the People Center.

Strolling Players

The Summerfest's troupe of strolling players will enact Shakespearean scenes in the Museum and elsewhere during the exhibition.

Shakespeare in Japan

On Saturday, August 1, at 1:00 P.M. in the People Center, the Japanese film *Throne of Blood* will be shown. Written, produced, and directed by Akira Kurosawa, the film is based on *Macbeth.* Discussion will follow.

Shakespeare in Armenia

A program, *Shakespeare and the Armenian Theater,* will be given in the People Center on Saturday, August 8, at 1:00 P.M. There will be readings from Shakespeare's works and dramatizations in both Armenian and in English.

Shakespeare in France

A program dealing with the translations of Shakespeare's works into French will be presented on Saturday, August 22, at 1:00 P.M. in the People Center. This bilingual program will include readings from French poets.

Shakespeare in Combat

A program entitled *Shakespearean Weaponry and Dueling* will be given on Wednesday, September 2, at 7:00 P.M. in the Education Hall. A demonstration of Elizabethan weaponry will be included.

Shakespeare in Italy

The Many Faces of Love: Shakespeare's Italy, a lecture with readings from *Romeo and Juliet, The Merchant of Venice,* and *Othello,* will take place on Saturday, September 5, at 1:00 P.M. in the People Center. Music from Verdi and other Italian composers who were influenced by Shakespeare will also be featured.

The Shakespeare Summerfest has been made possible by support from the National Endowment for the Humanities.

Look what we've brought back from Europe.

Hello, we're back again. This last trip to Europe added so many new titles to our list of imported Classical Music that we'll have to strain your eyes a little with itty-bitty typeface. You know that prices for imported Classical Music can be outrageous. But this can be changed. Here's how we're doing it: We buy large quantities with an ever stronger Dollar. We handle our own shipping. We cut overhead and sell directly by mail. And so our imports often cost far less than you'd expect. All recordings are pressed, printed and sturdily boxed in Europe. All are Stereo unless otherwise noted. All are factory-fresh European namebrands. As many of these sets are available for the first time in the U.S.A., not prices are for comparison only, based on the suggested list price for comparable LP sets.

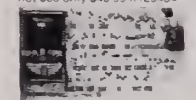


The Most Beautiful Madrigals. with the Collegium Vocale, Cologne. The listener will discover a treasure. Sung in Ger./Dutch/Span./Fr./Eng./Ital. cond. by W. Fromm. CBS Masterworks (79333). Made in Germany. Text Eng/Ger. ★★★ 3 LPs not $30 only $22.99 lt#29579.

Telemann: Banquet Music. Complete recording. From the year 1733. Music lovers can look forward to a year of grand instrumental work from the pen of Telemann. Subscriptions are due quarterly at 2 talers of Hamburg value. G. Leonhardt: Concerto Amsterdam. F. Brueggen: Grand Prix du Disque. First rate Telefunken (6.35298). Made in Ger. Text: Ger/Eng/Fr. Sumptuous box. ★★★★★★ 6 LPs not $60 only $34.99 lt#29295.

Paganini: 6 Concertos for Violin & Orch. With Salvatore Accardo who was able to read a score even before he could read or write. Charles Dutoit & London Phil. Top-qual. Deut. Gram. (2740121). Made in Ger. Text: Ger/Eng/Fr/Ital. ★★★★★ 5 LPs not $50 only $39.99 lt#29470.

John Dowland: The Bookes of Songs (1597 to 1603). Original Dylan of his tymes. The applause of them that judge is the encouragement of those that write. My first to books of aires speed so well that they have produced a third. (1603) Anthony Rooley & Consort of Musicke. Exc. Telefunken/Decca (6.35484). Made in Germany. Text: Eng./Fr/Ger. ★★★★★★ 6 LPs not $60 only $49.99 lt#29434.



Plainsong: An Anthology of Gregorian Chant. Puts you back in the 6th century monastery. Monk-monophony. Performed by Plainsong Choir of the Capella Antiqua, Munich. Fabulous Textbook in Latin/Eng/Ger/Fr. Precise MPS-Metronome (88010-4). Made in Germany. ★★★★ 4 LPs not $40 only $24.99 lt#29461.

Carmina Burana: 33 Songs from the Ong. Manuscript ca. 1300. Fore-tore-fore fathers music. Early Music Quartet. Very very rare Telefunken Das alte Werk (6.35319). Made in Ger. Text: Latin/Eng/Ger. ★★ 2 LPs only $19.99 lt#29294.

Harasiewicz plays Chopin. Collegium Musicum. Harasiewicz is presently considered the top interpreter of Chopin and this record is in big demand. Grand Prix Chopin Philips (6747017). Made in Holland. Text: Eng./Fr./Ger. ★★★★★★★★★★ ★★★ 14 LPs not $125 only $59.99 lt#29157.

Klemperer Conducts Beethoven. Complete 9 Symph. Missa Solemnis. Fidelio. 5 concertos for Piano & Orch. Leonore Overtures etc. etc. With Barenboim, Menuhin, Nilsson et al. EMI/Electrola (1C19753400/19). Made in Germany. Text: Ger. BLUE ANGEL EXCLUSIVE. ★★★★★★★★★★★★★★★★★★★★ 20 LPs only $79.99 lt#29401.

Beethoven: The 5 Piano Concertos & Choral Fantasia, Op. 80. New Philha. Orch. London. Barenboim & Klemperer. John Alldis Choir. Grand Prix du Disque. Edison. EMI/Electrola (1C19701890/93). Made in Ger. Text: Ger. ★★★★ 4 LPs not $35 only $19.99 lt#29249.

Beethoven: The String Quartets. Juilliard Quartet. R. Mann, C. Adam etc. CBS Masterworks (GM 101). Made in Ger. Text: Eng./Ger./Fr. ★★★★★★★ 10 LPs not $71 only $49.99 lt#29307.



Beethoven: Complete Symphonies. Gewandhausorch. Leipzig. Franz Konwitschny. With T. Adam, I. Wenglor, U. Zollenkopf etc. Radio Bremen. Beethoven like he has not been in a long time. Fontana (K71BA600). Made in Holland. Text: German. ★★★★★★★★ ★★ 6 LPs not $54 only $24.99 lt#29213.

Beethoven: Complete Piano Sonatas. Fried. Gulda. Award-winner Metronome/Amadeo (89007.11). Made in Ger. Text: Ger. ★★★★★★★★★★ ★ 11 LPs only $39.99 lt#29427.

Beethoven: Masterworks. Sym. #5. Concertgebouw Orch. Eugen Jochum. Sym. #9. Gewandhausorch. Kurt Masur. Piano Concerto #5. Concertgebouw Orch. Haitink. Violin Concerto in D. New Phil. harmonia Orch. Alceo Galliera, cond. Grumiaux: violin. Violin Romance #2 in F. Concertgebouw Orch. Haitink cond. Grumiaux: viol. Sonata #8 Op. 13 in C minor. Sonata #23 Op. 57 in F minor. Sonata #14 Op. 27-2 in C sharp minor. Claudio Arrau: piano. Philips (6768231). Made in Holland. Text: Eng./Fr./Ger. ★★★★★ 5 LPs only $19.99 lt#29591.

Beethoven: 9 Symphonies. 1977 Berlin Phil. H. v. Karajan. Tomowa-Sintow, Schreier etc. Deutsche Grammo (2740172). Made in Germany. Text: Ger. ★★★★★★★★ 8 LPs List $71 only $59.99 lt#29422.

Lute Music of the Renaissance. Walter Gerwig plays pieces from Germany, England, Italy & France. It was part of the education of the nobility as well as of the bourgeoisie to know this instrument to at least some degree. Meticulous Electrola/Harmonia Mundi (1499465/507). Made in Germany. Text: Ger./Eng. ★★★ 3 LPs not $30 only $19.99 lt#29346.

Klemperer Conducts Mozart. Complete: Cosi fan tutte. Nozze di Figaro. Magic Flute etc. Sym. No. 25, 29, 31, 33-41 etc. etc. Philharmonia & New Phil. London Wind Ens. etc. EMI/Electrola (1C19753714/38). Made in Ger. Text: Ger. BLUE ANGEL EXCLUSIVE. ★★★★★★★★★★★★★★★★★★★★★★★★★ 25 LPs only $95.99 lt#29500.



Mozart: Complete Piano Concertos. Daniel Barenboim & the English Chamber Orch. Cited as being a masterwork by a still young interpreter. EMI/Electrola (1C19752249/60). Made in Germany. Text: Eng. Ger. ★★★★★★★★★★★★ 12 LPs not $107 only $49.99 lt#29231.

Mozart: Symphonies 1-41. Berlin Phil. cond. by Karl Boehm. Deutsche Grammo (2720044). Made in Germany. Text: Eng./Fr./Ger. ★★★★★★★★★★★★★★★ 15 LPs not $134 only $95.99 lt#29397.

Mozart: Complete Violin Concertos. Bath Festival Orch. Y. Menuhin cond. & plays. EMI/Electrola (1C15352341/44). Made in Germany. Text: Ger. ★★★★ 4 LPs not $35 only $19.99 lt#29347.

Mozart: Idomeneo. Nicolaus Harnoncourt. Mozart Orchestra & Choir of the Zurich Opera. New DIGITAL recording on Telefunken (6.35547). Made in Germany. Complete libretto in German/English/Italian/French + complete Das alte Werk catalog. ★★★★ 4 LPs not $43.92 only $34.99 lt#29584.

Mozart: Wind Concertos. Bassoon B-Maj. Flute no. 1 G-Maj. Clarinette A-Maj. Oboe C-Maj. Flute, Harp & Orch. C-Maj. etc. Herbert v. Karajan cond. Berlin Philharmonics. EMI/Electrola (1C19702238/40). Made in Germany. Text: Ger. ★★★ 3 LPs not $26 only $19.99 lt#29369.

Gustav Mahler: The 9 Symphonies. Sir George Solti conducts London & Chicago Symphonies. Concertgebouw Orch. Amsterd. With H. Watts, R. Apollo, Lucia Popp etc. An assembly of Grammies. Edison Awards. Grand Prix du Disque. Deut. Schallplattenpreis. Wonderful. Telefunken Decca (6.35230). Made in Germany. Text: Ger. Silver embossed clothbd. box. ★★★★★★★★★★★★★★★ 15 LPs not $150 only $96.99 lt#29437.



Bach: Brandenburg Concertos 1-6. On the orig. instrum. with orig. orchestration. Concentus Musicus. Harnoncourt. Grand Prix du Disque. Telefunken/Das Alte Werk (6.35043). Made in Ger. Text: Eng./Ger./Fr. ★★ 2 LPs $17.99 lt#29205.

Bach: Complete Organ Works. Lionel Rogg. Considered by Grammophone Mag. to be the ultimate collection. EMI/Electrola (1C19714101/20). Made in Germany. Text: Ger. ★★★★★★★★★★★★★★★★★★★★ 20 LPs not $179 only $79.99 lt#29300.

Jacques Loussier: Play Bach. Loussier finally tracked down the swinging common denominator between baroque music and Jazz. (Rheinische Post, Duesseld.) All 5 Play Bach LPs freshly pressed by Telefunken/Decca (6.30115). Made in Germany. A BLUE ANGEL EXCLUSIVE. ★★★★★ 5 LPs not $39.90 only $25.99 lt#32101.

J.S. Bach: Orchestra Works. Brandenburg Concertos (orig. versions!) Suites for Orchestra 1-4. The Musical Offering. The Art of Fugue. Neville Marriner & Academy of St. Martin in the Fields (London). Excellent Philips pressing (6768232). Made in Holland. Embossed box. Ger. Text. ★★★★★★★ 7 LPs not $70 only $44.99 lt#29569.



J.S. Bach On the Original Instruments. Collegium Areum plays Brandenburg Concertos 1-6 & Overtures 1-4 as performed in the 18th century. Sought-after EMI/Harmonia Mundi (1C19753000). Made in Germany. Text: Ger. ★★★★ 4 LPs not $40 only $19.99 lt#29510.

J.S. Bach: 6 Suites for Violoncello. Played by Pablo Casals, the most important cellist of our times. Deutsche Zeitung: Masculine, dry. Bach moved into timeless-ness. Grand Prix du Disque. Rare historical mono recording. EMI/Decapo (1C14700892/4). Made in Germany. Text: Ger. ★★★ 3 LPs not $30 only $19.99 lt#29511.

Verdi: 7 Operas. Celebrating 200 years of La Scala, Milan. Rigoletto. Trovatore. La Traviata. Un ballo in Maschera. Macbeth. Don Carlos. Simon Boccanegra. Cond. by Kubelik, Abbado, Serafin etc. Beautiful set. 7 boxes in 1 box, complete libretti. Deutsche Grammo (2740197). Made in Germany. ★★★★★★★★★★★★★★★★★★★★★★ 21 LPs not $209 only $99.99 lt#29317.

The Best Piano Concertos. Beethoven #3, 4, 5. Mozart #8, 20, 21, 23, 26, 27. Chopin 1, 2. Grieg Op. 16. Schumann Op. 54. Brahms 1, 2. Liszt 2. Tchai. #1. Rach. #1, 2, 4. Ravel, etc. Barenboim, Arrau, Wessenberg, Richter, etc. EMI/Electrola (1C19753660/94). Made in Ger. Text: Ger. ★★★★★★★★★★★★★★★ 15 LPs only $65.99 lt#29505.

Schubert: The String Quartets. Melos Quartet Stuttgart. Deutsche Grammoph. (2740123). Made in Germany. Text: Engl./Ger./Fr. ★★★★★★★ 7 LPs List $62 only $49.99 lt#29475.

Concentus Musicus: N. Harnoncourt & Ensemble. Haydn. Purcell. Telemann. Biber. Muffat. Schmelzer. Legrenzi. Fux. instrumental music from 16th cent. Fr. Engl., Italy & Ger. Metronome/Amadeo (89003-7). Made in Germany. Text: Ger. ★★★★★★★★★★★★★★★★★★★★★★★★★★★★ 7 LPs only $29.99 lt#29685.



Vivaldi. 82 Concerti. The most complete anthology ever by Musici. Grand Prix du Disque. Edison Award. Deutscher Schallplattenpreis. 12 hrs. of Baroq. mus. Philips (6747029). Made in Holland. ★★★★★★★★★★★★★★★★★★ 18 LPs not $161 only $65.99 lt#29502.

Schumann: Piano Works. With Claudio Arrau. Op. 2, 11, 13, 17, 16, 19, 20, 21, 26, 28, etc. Philips (6768084). Made in Holland. Text: Eng./Ger./Fr. ★★★★★★★★ 9 LPs not $80 only $59.99 lt#29410.

Brahms: Complete Chamber Music. The Piano Trios. The String Sextetts. The Piano Quartets. The Piano Quintet. The String Quartets. The String Quintets. The duo Sonatas. With Haas, Grumiaux, Beaux Art Trio, Quartetto Italiano, Ber. Phil. Octet. Good ol' Philips (6768146). Made in Holland. Text: Eng./Ger./Fr. ★★★★★★★★★★★★★★★★★★★★★★★★★★★★★ 15 LPs not $150 only $79.99 lt#29558.

Brahms: Complete Symphonies, Acad. Festival & Tragic Overtures Op. 80 - 81. Phil. Orch. London. Klemperer. EMI/Electrola (1C19750034/7). Made in Germany. Text: German. ★★★★ 4 LPs not $35 only $16.99 lt#29131.

Handel: Works for Orchestra & Concertos. Complete Concerti Grossi op. 3 & 6. 16 Organ Concertos. Water Music. Royal Fireworks. Music for Ballet. Oboe conc. etc. Academy of St. Martin cond. N. Marriner. Telefunken/Decca (6.35358). Made in Germany. Text: Ger. ★★★★★★★★★★★★★★★★★★★★★ 11 LPs not $98 only $75.99 lt#29436.

Handel: 16 Concerti for Organ & Orch. Lionel Rogg on the organ of St. Michel, Gaillac, with Georges Armand, Orch. de Chambre Toulouse. Fine EMI/Electrola (1C16314 05154). Made in Ger. Text: Eng./Ger. ★★★★ 4 LPs not $40 only $19.99 lt#29248.

The Beaux Arts Trio plays Piano Trios, Piano Quartets and Piano Quintets by Haydn, Mozart, Beethoven, Schubert, Mendelssohn, Schumann, Brahms, Dvorak, Tchaikovsky & Ravel. Philips (6768238). Made in Holland. Text: Eng./Fr./Ger. ★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★ 16 LPs only $49.99 lt#29567.



12 Orig. Hendrix LPs. Orig. covers (inc. Ladyland). Are you experienced. Bold as love. Band of Gypsies. Isle of Wight. Cry of love. West Coast Seattle Boy. Rainbow Bridge. Smash Hits. Monterey. Midnight Lightning. Crash Landing. Blues. Ed. Ladyland. Plus rare single. Book. Polydor (2625038). Made in Germany. ★★★★★★★★★★ ★★ 12 LPs not $95 only $85.99 lt#23947.

Dinu Lipatti. (The James Dean of Classical Music.) Selected Works from Bach, Brahms, Chopin, Enescu, Grieg, Liszt, Mozart, Ravel, Schubert, Schumann & Scarlatti. Important hist. Mono rec. EMI/Electrola (1C19753780/86). Made in Ger. Text: Germ. ★★★★★★★ 7 LPs only $29.99 lt#29554.



Verve Jazz Box. A hommage to one of the most important Jazz labels and to one of the best Jazz producers, Norman Granz. A collection of Jazz heavies from the beginnings to now. Louis Armstrong, Ella Fitzgerald, Jimmy Smith, Stan Getz, Wes Montgomery, Oscar Peterson, Charlie Parker, Billie Holiday, Gerry Mulligan, Gene Krupa, Duke Ellington, Count Basie, Duke Ellington, Bennie Goodman, Django Reinhardt, Modern Jazz Quartet, Bill Evans, Dizzy Gillespie, Chick Corea and Return to Forever. John McLaughlin. Only LP side each. A history of Jazz in a bitter sweet chocolate brown box. Gold-printed booklet. Verve 2625011. ★★★★★★★★★ ★★ 10 LPs not $80, only $49.99 lt#32100.



Rolling Stones Story. The good old Decca-times. Stones 1. Around & ar. Stones 2. Out of our heads. Aftermath. Got live if you want. Satanic Majesty. Beggar's Banq. Let it Bleed. Ya-yas Out. Metamorphosis. Btw. The Buttons. 2 historical Mono LPs. Telefunken/Decca (6.30118). Made in Germany. ★★★★★★★★★★★★★★★★★★★★★★ 12 LPs not $95 only $74.99 lt#24213.

Call Toll Free: (800) 446-7964

Virginians, pls. call (804) 293-5197. We are here from 9-5 EST. Ask for Bambi, or leave a message.

Okay, folks, I'll give you a try!

Quant.	Of Item#.	$ each.

Quantities are limited. Add $3 for post&hdlg. VA residents add 4½% sales tax. 10 day money back guarantee for unplayed records.

FOREIGN ORDERS: Visa/MC, Intl. money order or cashier's check in U.S. funds only. Add 10% for p&h, $7.50 minimum.

( ) I have enclosed check/money order for $ (allow 3 weeks for personal checks). ( ) Send it C.O.D. I will pay add. post & here's $10 as a deposit.

( ) Charge it to my ( ) MC ( ) Visa (fast delivery!)

Card#

Exp. Sign

Name (print)

Address

City

State Zip

( ) Please send me your catalogue NA8

Blue Angel, Inc. 1738 Allied St. Charlottesville, VA 22901



Planter's Lunch

A carpetbagger's kitchen tour of the New Old South

by Raymond Sokolov

North of Charleston, in that swampy paradise for waterfowl known as the South Carolina Low Country, is a 9,000-acre quondam rice plantation I will call Tara. It began as a cypress swamp where Indians fished. Toward the end of the seventeenth century, European settlers discovered that rice would thrive in the murky waters that ran through the plantation to the Atlantic. Slaves who spoke Gullah, the West African–English patois, extirpated the cypress and dug dikes for rice impoundments. The crop was so lucrative that it took two centuries before a combination of hurricanes, competition from more economical rice fields in other states, and Reconstruction brought an end to Carolina riziculture. The *coup de grâce* came in 1942, when hydroelectric damming let seawater flow inland, turning the Low Country into a brackish fen.

By then, certain rich Yankees had bought control of many of the old estates. They converted the impoundments into game preserves and managed the salty water so that it produced food for shootable birds. The only constant in this human-churned environment was the black population. Some descendants of the slave communities remained, while rice mills and whole "streets" of slave cabins collapsed.

One such black retainer was on hand, early in this century, when Tara's new Yankee owner arrived unannounced, landing a private plane in a field. The black servant had never seen a plane before, never heard of one, but he gathered his courage and walked forward to greet the young visitor from the sky. "Hello, Massa Jesus," he said, "and how's your Pa?"

Descendants of slaves carry on the cooking traditions of South Carolina's Low Country.

Today, that man's grandson carries on the family tradition at Tara. He lives by the old and crumbling rice mill, and he speaks Gullah with his wife, who cooks plantation meals in the big house. Her fried chicken is a paradigm of the best in southern cooking. Her hot biscuits define delicacy in baking. When this dignified, taciturn old woman makes crab cakes, they are light and crisp and almost pure crab meat.

Like other traditional Low Country cooks, she uses rendered pork fat from bacon or hog jowl, where most of us would use butter or oil. When she makes shrimp stew, she begins by frying bacon in the pot.

There is nothing more fundamental to a cuisine than the fat it uses. In his classic study of French regional cooking, *The Food of France,* Waverley Root divides France into three parts: the "domains" of butter, olive oil, and lard (meaning any kind of pork fat, as well as goose fat).

In the Old South, salt-cured pork was the standard source of cooking fat, even in seafood dishes. Oysters were prepared this way, for example, in brown oyster stew with benne, or sesame seed (see recipe). Benne was introduced by slaves, who considered it a lucky plant. Modern versions of this Afro-American stew are done, not with cured "side meat" or jowl, but with more readily available bacon.

Oysters continue to be a mainstay of Low Country seafood. At Tara, on special occasions, local gentry gather for an open-air oyster roast. This feast is similar to the New England clambake, but it is far simpler. Indeed, a Low Country oyster roast requires nothing except a fire, a grill, bushels of select McClellanville oysters from just down the coast, and burlap sacks. You dump the oysters on the fire, cover them with burlap, and as soon as they start to open, you shovel them onto a table covered with paper.

Guests are provided with one work glove, to protect the hand that holds the oyster, and an oyster knife, to cut the bivalve loose. I consumed several dozen juicy charcoal-roasted oysters one nippy evening. As if this were not enough, the natural order of things in the Low Country supplies an extra bonus for the omnivorous diner at an oyster roast. Every so often, one of the oysters contains a small, pink soft-shelled crab.

Pinnotheres ostreum, called the pea or oyster crab, is a tiny creature that attains a maximum width of one and a half centimeters. At an early stage, it crawls inside an oyster and installs itself for a lazy, commensal existence. Harmless to its host, the oyster crab merely uses the larger animal as an apartment. Male oyster crabs do migrate in search of a female residing in another oyster. But once the uninvited male visitor has copulated, he dies.



Our forebears prized these tiny shellfish. Alan Davidson, in *North Atlantic Seafood,* reminds us that George Washington loved them so well that *P. ostreum* was almost renamed the Washington crab. The first president often saw them served floating on top of an oyster stew. And in palmier days, Americans frequently ate oyster crabs sautéed or deep-fried, with or without oysters. Davidson also mentions two recipes from a Philadelphia cookbook published in 1901: an omelet containing twenty-five to forty oyster crabs and a "real extravaganza" called Canopy à la Lorenzo, which consisted of a bell-shaped crouton stuffed with fifty oyster crabs, one-fourth of a truffle, crab meat, chicken meat, and cream, all dusted with bread crumbs.

I doubt that anyone in the South Carolina Low Country still serves oyster crab as a separate dish, but the culinary past persists at old homes like Tara because the memory of how to live off local products persists. And the old cypress swamps still produce most of the old-time foods, including a yellow-bellied turtle called terrapin or cooter (see recipe). Certain foods common all over the South—Jerusalem artichoke, mustard pickle, pickled okra—are widely available in Charleston supermarkets. At the gourmet shop in the shopping arcade in Charleston's boutique-filled former slave market, you can buy folkloric, if foxy, wine fermented from the juice of the scuppernong grape.

Meat counters routinely sell shreds of bacon for rendering. And the local predilection for rice has more than survived the demise of South Carolina's own rice production. Local cookbooks are filled with recipes for pilaus: elaborate risottolike dishes garnished with okra, chicken, or shrimp. The prevailing local pronunciation of pilau, no doubt a Gullah adaptation, sounds like "perloo."

So Low Country cooking traditions are not all shriveling up in the face of competition from the master culture. But culinary tradition in and around Charleston can only be as vigorous as the people who cook it. And eat it.

The ideal mode of transmission of traditional food knowledge is from an expert cook to an apprentice living in the same household, under culturally and agriculturally stable conditions. This perfect set of circumstances obtained in the South in general, and on





The superb plantation cook, left, probably the last in her line, made a shrimp stew for the oyster roast, above.

large southern plantations in particular, for generations. Even after Low Country plantations were sold to Yankees during the "Second Reconstruction" following the 1929 stock market crash, kitchen staffs still carried on the practices of their mothers and grandmothers. Only a generation ago, there were still blacks at Tara who had never set foot off the property.

Today, the Tara cook is probably the last in her line. And even her cooking shows signs of a corrupting contact with the outside world and its convenience foods. Her shrimp stew, for example, contains bottled ketchup, Texas Pete hot sauce, and Lea and Perrins steak sauce.

In Charleston, the same discontinuity is detectable even in places where tradition is most militantly affected. For example, the local Junior League cookbook, *Charleston Receipts,* includes old-fashioned cooking terminology, but a woman on the committee responsible for the book told me that she didn't understand expressions such as "a blade of mace."

Actually, it is a good thing that the texts of these recipes, with their antique references to blades and pecks, have been scrupulously preserved. The honest scribes at the Charleston Junior League have reproduced on paper the practice of their mothers and their mothers' cooks without so much as a phrase of modern revision. But how much longer the women in Charleston's stately and well-kept homes will continue the New Year's Day tradition of cooking Hoppin' John, that hearty combination of rice and cowpeas (small legumes, also called field peas, resembling miniature black-eyed peas) is not clear. The dish, which gets its special flavor from rendered hog jowl or bacon, dates back at least as far as 1841, when, according to oral tradition, it was hawked in the streets of Charleston by a crippled black who identified himself as Hoppin' John.

This superb concoction will continue to stick to Low Country ribs as long as someone keeps on growing cowpeas, as long as there is a demand from those astute enough to crave this savory source of complete protein. Other aspects of South Carolina Low Country cooking are more fragile, more dependent on social context and culinary skill. I have in mind the lunch that took place after Tara's most recent oyster roast.

Inevitably, some of the roasted oysters were left over. With consummate delicacy, the old cook breaded them lightly and fried them. They came out crisp, but still succulent and full of the smoky taste from the previous night's outdoor feast.

At Tara, they can still pull off this sort of culinary magic, but Tara is a special place, costly to maintain. It is also gravely menaced by a plan to redredge neighboring rivers, which will desalinate Low Country rice impoundments and make them unfit for supporting the carefully nurtured plants that attract the game birds that currently attract wealthy Yankee owners. The trend, in any case, is for such Low Country plantations to be donated to the public as nature conservancies. In one such 20,000-acre tract that I toured, the endangered red-cockaded woodpecker finds a safe niche, and a protected herd of deer feed on corn set out for them in troughs. The former black staff is long gone, their church abandoned. Nature stands still in this place, embalmed by vigorous and ingenious human efforts to maintain a hunter's paradise, but the human presence has dwindled to a small band of environmental biologists, gifted at providing a welcome for the semipalmated plover, but not primarily concerned with the survival of shrimp stew.

Raymond Sokolov, a writer with an interest in the history and preparation of food, is editor of Book Digest.



Louisa Stoney's Brown Oyster Stew with Benne (Sesame) Seed

- 4 slices bacon
- 1 large onion, sliced
- 2 tablespoons flour
- 1½ cups oyster liquor, approximately
- 2 tablespoons sesame seeds, parched in a heavy pan on the stove until browned
- 2 cups shucked oysters
- Cooked rice or hominy

1. Fry the bacon and onion until brown, then remove from the pan with a slotted spoon.
2. Shake the flour into the hot grease and stir vigorously until flour is brown.
3. Remove from heat and gradually add oyster liquor until the mixture is smooth.
4. Pound the sesame seeds, using mortar and pestle.
5. Return flour mixture to heat and stir until slightly thickened. Then add sesame seeds.
6. Lastly, add oysters and poach until the edges curl. Serve over rice or hominy.

Yield: 6 servings

Turtle Soup

- 1 large or 2 small yellow-bellied rice-field turtles (*Pseudemys scripta scripta*), preferably female
- Salt
- Pepper
- 1 teaspoon thyme
- 1 large onion, chopped

1. Butcher turtle as follows: Chop off head. Let stand, head end down, until completely bled. Scald in boiling water for 5 minutes. Then crack or cut through shell with a hatchet, taking care not to damage eggs. Reserve eggs. Cut away the hind quarters and forequarters, the liver, and a strip of white meat adhering to the back of the shell. Peel off outer skin and discard.
2. Bring 4 quarts water to a rolling boil. Add skinned turtle meat and liver, along with seasonings and onion. Reduce heat and simmer for 2 hours or until meat begins to fall off bones.
3. Remove the meat and liver with a slotted spoon. Pull off bones and discard.
4. Chop or grind meat. Chop liver roughly. Return meat and liver to the soup. Correct seasoning. Return to the boil, reduce heat, and add turtle eggs. Continue cooking for 20 minutes.

Yield: 6–8 servings

Connie Bull's Jerusalem Artichoke Relish

- 1 medium cabbage, chopped
- 3 quarts Jerusalem artichokes, well scrubbed and chopped
- 2 large bunches celery, chopped
- 1 quart onions, peeled and chopped
- 6 bell peppers (preferably 3 green and 3 red), seeded, stemmed, and finely chopped
- 1 large cauliflower
- 2 cups salt
- ½ cup flour
- 6 tablespoons dry mustard
- 1 tablespoon allspice
- 3–4 cups sugar, to taste
- 1 tablespoon turmeric
- 1½–2 quarts vinegar

1. Combine cabbage, Jerusalem artichokes, celery, onions, and peppers in a large crock or bowl.
2. Break flowerets off cauliflower and crumble them. Stir together with other vegetables.
3. Dissolve salt in 1 gallon cold water. Pour over vegetables.
4. Cover with towel and let stand for 24 hours.
5. Drain thoroughly.
6. Combine remaining dry ingredients in a bowl, adding just enough vinegar to produce a smooth paste.
7. Bring unused vinegar to a boil. Stir in the paste. Then add vegetables and return to the boil. Reduce heat and simmer for 20 minutes.
8. Spoon into sterilized jars while relish is still hot and seal immediately.



The man behind this hand is Michael Coleman.

The company behind this man is IBM.

There's a story behind both of them.

After the Marines and Vietnam. Coleman earned his MBA and began selling computers for IBM. Promotion followed promotion. and he now teaches our customers how to get the most out of their computers.

His success doesn't surprise us. People with disabilities keep proving that they are as capable as other workers. As reliable. As ambitious. And just as likely to succeed.

At IBM the proof is everywhere. in every part of our business.

The same is true at other companies.

Yet. some people just won't believe that the disabled can do the job. It has to make you wonder who's handicapped.

And who isn't.

IBM®

For free information about what disabled persons can do for your company, write. Industry-Labor Council. National Center on Employment of the Handicapped. Human Resources Center, Box 471, Albertson, N.Y. 11507.

Imported by The Paddington Corporation, New York, N.Y. 34 Proof © 1981



BAILEYS.
THE ORIGINAL IRISH CREAM LIQUEUR.

THE CREAM IS REAL. THE SPIRITS ARE REAL.
ONLY THE TASTE IS MAGIC!



5.06(747)M1

NATURAL HISTORY



9/81

1981

October

SUN	MON	TUES	WED	THURS	FRI	SAT
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

November

SUN	MON	TUES	WED	THURS	FRI	SAT
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

December

SUN	MON	TUES	WED	THURS	FRI	SAT
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

NATURAL HISTORY

A Gandharan frieze of gray schist from about the fourth century A.D. The toga worn by the Buddha, center, indicates the Greco-Roman influence on Indian art. The frieze measures about 10 x 15 x 2½ inches. Gift from the Lester Wolfe Collection. Photograph by Arthur Singer, AMNH



The page edges, gilded with a special tarnish-free finish, adding protection as well as beauty to each volume. Magnificent illustrations, some of them in full color. And the bookpaper itself, specially milled to last for many generations.

For these luxurious volumes will be crafted to *retain* their beauty. So that this private library will be a lasting heirloom. To be treasured by you and your family now, and by your children and your children's children in years to come as "the fit inheritance of generations."

Imagine the satisfaction of glancing around your living room and seeing this treasury of great literature—the fifty beautiful volumes which make up The Family Library—the rich leather of their handsome, distinctive spines enriched by 22 karat gold ornamentation.

Imagine the pleasure of anticipation, as you slide one of the volumes from its place, open it at the bound-in ribbon marker, and begin to read. Enjoying the handsomely printed text, the superb, evocative illustrations.

And imagine, too, seeing your family immerse themselves in these challenging and enduring works of literature—and reaping all the rich rewards which that entails.

Return your application
postmarked by September 30, 1981.

The Family Library of the World's Great Books is being offered at this time at the attractively low price of just $19.50 per volume. But it is available at this price *only* to those who subscribe to the complete collection.

The accompanying application assures you of the *guaranteed* price of just $19.50 per volume for the entire Family Library. And you have the right to cancel your subscription at any time upon 30 days' written notice, or return any book, for any reason.



within 30 days. To be accepted, however, your subscription application should be postmarked no later than September 30, 1981.

THE BOARD OF ADVISERS

The Franklin Library gratefully acknowledges the assistance of the very distinguished Board of Advisers in selecting the fifty great books to be included in The Family Library



ISAAC ASIMOV
Noted scientist, professor, critic and writer



PAULINE FREDERICK
Noted correspondent, author and news analyst



DR. BRUNO BETTELHEIM
Distinguished psychologist and author, perhaps best known for his work with children



HELEN HAYES
One of America's greatest dramatic actresses, winner of two Academy Awards



RALPH ELLISON
Distinguished professor and author of the award-winning novel *Invisible Man*



JEAN KERR
Widely popular writer of perceptive and humorous plays and books.

© 1981 FM

SUBSCRIPTION APPLICATION

The Family Library of the World's Great Books

The Franklin Library
Franklin Center, Pennsylvania 19091

Please enter my subscription to *The Family Library of the World's Great Books*, consisting of 50 volumes bound in genuine leather combined with fine fabrics. The books will be sent to me at the rate of one each month, and the issue price of $19.50* per book will be guaranteed to me for the entire library. However, I have the right to cancel my subscription at any time on 30 days' written notice, or return any book within 30 days.

I need send no payment now. I will be billed for each volume, individually, in advance of shipment.

**Plus my state sales tax and $2.50 per book for shipping and handling, subject only to postage increases.*

Signature _____
ALL SUBSCRIPTIONS ARE SUBJECT TO ACCEPTANCE

Mr.
Mrs.
Miss _____
PLEASE PRINT CLEARLY

Address _____

City _____

State, Zip _____

Please mail by September 30, 1981.

NATURAL HISTORY

Vol. 90, No. 9, September 1981

American Museum of Natural History
Robert G. Goelet, President
Thomas D. Nicholson, Director

Alan Ternes, Editor
Judith Friedman, Managing Editor
Thomas Page, Designer
Board of Editors: Carol Breslin, Sally Lindsay, Frederick Hartmann, Vittoria Maestro, Rebecca B. Finnell
Florence G. Edelstein, Copy Chief
Rita Campion, Copy Editor
Kay Zakariasen, Picture Editor
Douglas J. Prestan, Publications Editor
Lillian Berger
Editorial Advisers: Malcolm Arth, James W. Atz, Niles Eldredge, Kenneth L. Franklin, E. Craig Morris, Norman Newell, Thomas D. Nicholson, Martin Prinz, Gerard Piel, Nina Root

David D. Ryus, Publisher
Bradford D. Smith, Business Manager
Frederick E. Grossman, Production Mgr.
Debra Buck McCord, Asst. Production Mgr.
Ernestine Weindorf, Administrative Asst.
Elaine M. Callender, Advtg. Production Mgr.
Lauren Krenzel

Cary Castle, Circulation Manager
Bob Bruno, Fulfillment Mgr.
Ramón E. Alvarez, Circulation Asst.

NATURAL HISTORY *(ISSN 0028-0712), incorporating Nature Magazine, is published monthly by the American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024. Subscriptions: $15.00 a year. In Canada and all other countries: $18.00 a year. Second-class postage paid at New York, N.Y. and at additional offices.*

Copyright © 1981 by American Museum of Natural History. All rights reserved. No part of this periodical may be reproduced without written consent of Natural History. *The opinions expressed by authors do not necessarily reflect the policy of the American Museum.* Natural History *is indexed in* Reader's Guide to Periodical Literature.

Advertising Offices:
Natural History Sales
488 Madison Avenue
New York, N.Y. 10022
President of Sales, Arthur Hill Diedrick
Advertising Manager, Katherine José

Telephone Numbers:
Advertising Sales (212) 826-9467
Museum Information (212) 873-4225
Subscription Orders (800) 247-5470
(800) 532-1272 (in Iowa)

Change of address notices, undeliverable copies, orders for subscriptions, and other mail items are to be sent to
Natural History Membership Services
Box 4300
Bergenfield, New Jersey 07621

4 Authors

6 A Matter of Lights and Death *John C. Avise and Robert L. Crawford*
On overcast nights, tower beacons hold a fatal attraction for many birds.

16 This View of Life *Stephen Jay Gould*
Quaggas, Coiled Oysters, and Flimsy Facts

30 Bios *David L. Mulcahy*
Rise of the Angiosperms

36 Monkey Moves *E. D. Starin*
While a female red colobus monkey can switch troops easily, the same move can be fatal for a male.

44 Saturn's Suprises *Andrew P. Ingersoll*
Secret "pushers" help form its many rings.

54 Art of the Rain Forest *Sally Price and Richard Price*
Slavery and a century of warfare did not destroy the vibrant creativity of Suriname's Maroons.

64 The Tibet Connection *Elmar R. Reiter*
Our daily weather is influenced by the high landmasses of Asia.

72 At the American Museum
Mastodon Memories

76 The Tourist as Pilgrim *Colin Turnbull*
Holy Places and People of India

82 Celestial Events *Thomas D. Nicholson*

88 Additional Reading

92 Books in Review *Stephen Jay Gould*
Darwin's Creatures

98 A Matter of Taste *Raymond Sokolov*
Roots

Cover: *A male red colobus monkey, about three years old, faces perils, rejection, and even death if he leaves his troop in The Gambia of West Africa. Photograph by E. D. Starin. Story on page 36.*

"mmmm"



KAHLÚA® Black Russian

KAHLÚA® White Russian

The true classic: an ounce of Kahlúa to two ounces of vodka on the rocks. For a delicious change of taste, just add cream or milk. And do send for the Kahlúa recipe book. Compliments of the house.
Maidstone Wine & Spirits Inc.,
116 No. Robertson Blvd., Los Angeles CA 90048.
© 1980 Kahlúa. Coffee Liqueur from Sunny Mexico. 53 Proof.

Authors

There is no question about the commitment of **E. D. Starin** to the study of wild primates. She has done fieldwork on chimpanzees in the Gombe Stream National Park in Tanzania, on langur monkeys in the Gir Forest of India and in Sri Lanka, on titi monkeys in Peru, and since 1978, on western red colobus monkeys in the Abuko Nature Reserve in The Gambia. Starin reports that she now dreams about colobus, does chi squares (statistical tests) in her sleep, and would like to remain in The Gambia forever. Her research, concentrated on the socioecology of the colobus, is conducted under the auspices of the Wildlife Conservation Department of The Gambia. Starin is a Ph.D. candidate in anthropology at the City University of New York.

Andrew P. Ingersoll was born in Chicago, grew up in New York City, went to college in New England, and now lives in California. An atmospheric scientist, Ingersoll was an investigator on the *Voyager* missions to Jupiter and is serving in a like capacity on the *Voyager 1* and *Voyager 2* missions to Saturn. Ingersoll was one of a group of scientists on the *Voyager* project team given NASA's Exceptional Scientific Achievement Award for their work. A professor in the Division of Geological and Planetary Sciences at the California Institute of Technology, Ingersoll has a Ph.D. in atmospheric physics. He specializes in planetary temperatures, heat budgets, winds, and climates. Much of his time is devoted to teaching and processing spacecraft data. A devoted family man, he is also a dedicated jogger who tries to put in about five miles a day, even when the exercise has to be done in place.



Interested in the varied historical experiences of Afro-American peoples, **Sally Price** and **Richard Price** have done extensive fieldwork among the Maroons of Suriname, the former Dutch colony in South America. The Maroons are the descendants of slaves who escaped from plantations in the colony and established independent communities in the rain forest. Although the initial focus of their study was not the arts of the Maroons, the Prices were eventually led to investigate the subject because of the Maroons' own concern with aesthetic ideas and products. The Prices are spending a year in the Netherlands doing additional research: Sally Price has a National Science Foundation postdoctoral fellowship to study Maroon folk tales, and Richard Price, on leave from his position as chairman of the Department of Anthropology at The Johns Hopkins University, is completing two books on early Maroon history, supported by a Fulbright Fellowship.





In the summer of 1980, **Elmar R. Reiter** traveled to Beijing (Peking) to attend an international symposium on the role of the Tibet plateau in meteorology. Afterward, he and a group of other scientists crossed the plateau by car and jeep as guests of the government of the People's Republic of China. That trip not only provided him with a new perspective on computer modeling of global weather patterns, but also gave him the opportunity to indulge his hobby of photography. Reiter, who holds a Ph.D. in meteorology and geophysics, is a senior professor in the Department of Atmospheric Science at Colorado State University in Fort Collins. He is the author of "Rapid Rivers of Air," an article on jet streams that appeared in the March 1975 issue of *Natural History.*



The Soligor 80-200mm Expand Your Horizons By Getting Close.



You've got a terrific 35mm SLR camera, but not all of your shots are terrific. Some suffer from too much unwanted scenery, some from tiny people in big frames... shots that didn't work because your creative I.Q. was more than your *lens* could handle.

That's right, lens. But, Soligor has a solution: the affordable, innovative Soligor 80-200mm One-Touch Zoom + Macro lens that lets you and your camera turn blah into beauty.

Zoom in to crop out extraneous details. Bring your subjects up to 4 times closer than a standard lens can. Frame your shots exactly as you want them, and Soligor quality captures them faithfully. Create exciting portraits, instead of just pictures of people; capture a still life or sports action as the kind of picture you bought your camera to get; experiment with amazing close-ups, thanks to macro ability. And it's all so easy with Soligor's single One-Touch control for zoom, focus and macro.

If some of the zip has gone out of your picture taking, zip down to your Soligor dealer and try our 80-200mm on your Canon, Minolta, Pentax, Olympus, Nikon or other fine camera. Or, write for full information.

SOLIGOR®
MAKES THE DIFFERENCE

AIC Photo, Inc. Carle Place, N.Y. 11514
In Canada Kingsway Film Equipment Ltd Ontario

A Matter of Lights and Death

by John C. Avise and Robert L. Crawford

Every year, large numbers of birds strike transmitting towers. At one Florida tower, the casualties are helping scientists answer questions about avian migration

Supported by a maze of guy wires radiating to ground points up to 800 feet from its base, the WCTV transmitting tower in northern Leon County, Florida, looms above the station. Early one morning in October 1979, a quick survey of the grounds, thirty-four grassy acres as closely mowed as a golf fairway, reveals a score of fluffy clumps—the remains of migrating birds that struck the 1,010-foot tower during the night. The kill appears to be a typical one for an autumn night with overcast skies and northerly winds; a strong cold front might have brought down ten times as many birds. Within an hour, the dead have been collected and recorded: five house wrens, three savannah sparrows, three palm warblers, two common yellowthroats, two long-billed marsh wrens, two yellow-billed cuckoos, one grasshopper sparrow, a wood thrush, a chimney swift, a yellow-throated warbler, a pine warbler, a scarlet tanager, an indigo bunting, and an American coot. The corpses are hurried to the nearby Tall Timbers Research Station, a biological station perhaps best known for its work on fire ecology, where they are bagged, labeled, and placed in a freezer for later study.

In 1955, ornithologist Herbert L. Stoddard, Sr., initiated the study of birds killed at the WCTV tower, and nearly every morning for the past twenty-six years, researchers have collected, cataloged, and preserved the casualties. Stoddard himself, who was a founder and vice-president of Tall Timbers, checked the tower almost daily until 1967, when advancing age finally limited his activities. A succession of workers (most recently, Robert Crawford) have carried on the survey.

The loss of an average of 1,600 birds every year is regrettable, but the WCTV tower kills have been put to good use over the years. They have been made available for a wide range of scientific studies requiring large numbers of specimens. Dozens of publications have resulted, on topics ranging from levels of pesticide residues to genetic relationships, as revealed by protein comparisons, to energetics and fat metabolism. In addition, the collection has provided thousands of museum reference specimens and skeletal preparations. The long-term survey itself provides a wealth of information that could not readily be obtained in any other manner and that can help answer questions about avian migration. Which species are nocturnal migrants? What are the relative abundances, particularly of species that are difficult to separate in the field (such as the *Empidonax* flycatchers)? At what time of year does each species migrate? Is there differential mortality by age or sex? The survey has also contributed to a growing body of knowledge on weather conditions and other factors that influence migration and mortality at fixed structures.

At the WCTV tower, kills occur virtually every night from mid-August to mid-November. Moderate numbers of migrants are often killed under perfectly clear skies, but the toll increases markedly with overcast conditions, especially when the wind is from the north. These conditions are often associated with the passage of a cold front, the boundary between cold and warm air masses. Behind the front, airflow from the north apparently stimulates large flights of migrants. The birds encounter storm systems along the edge of the front and fly lower than they normally do, under the overcast and within tower heights. In addition, birds become disoriented around tower lights when the moisture droplets associated with overcast conditions increase the area illuminated by refraction. For a passing front to produce a large kill, however, a pool of physiologically primed migrants, accumulated in the presence of earlier, southerly winds, is usually necessary.

The slaughter at WCTV is less protracted and more erratic in the spring than in the autumn. Spring migrants also take advantage of wind patterns to aid their flight, moving with the southerly winds blowing out of the Gulf of Mexico. As is true in the fall, clouds associated with approaching weather fronts increase the danger of collision with the tower.

Since only a fraction of the birds that migrate south in the fall survive to re-

What your home could have in common with the Met, the Tate, and the Louvre



Helen Rundell's *Shelter Island*, original lithograph. Signed limited edition of 175.



Joan Miro's *Obra Grafica: Barcelona '78*, original lithograph. Signed limited edition of 75.



Kathy Jakobsen's *Mr. Cole's Granary*, original lithograph. Signed limited edition of 275.



M. William Schlesinger's *La Siesta*, original serigraph. Signed limited edition of 225.



Tjelda Michas *Pansy Orchid*, original serigraph. Signed limited edition of 250.

In your own home, you can exhibit original work by artists who are represented in the world's great museums and galleries.

Artists like Calder. Chagall. Dali. Miró. Picasso. Vasarely.

At the Original Print Collectors Group, we offer moderately priced limited edition prints by these and other well-known artists.

Our offerings include signed original etchings, engravings, and silk-screen prints.

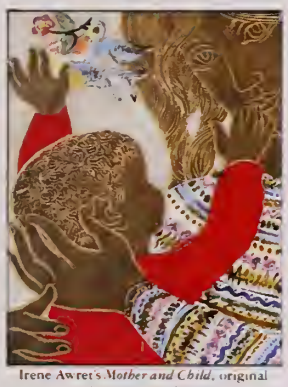
Each print we offer is signed and numbered by the artist. Custom-framed. Accompanied by a certificate of authenticity and a full money-back guarantee.

And each print has been chosen not only for its beauty but for its investment value.

(Works by the artists we offer tend to appreciate, sometimes as much as 30% in a single year. Perhaps that's why *The Wall Street Journal*, *Business Week*, *Money*, AP, *Barron's* and UPI have quoted us as an authority on investing in art.)

For more information, send in the coupon. There's no obligation.

You'll find out about the special pleasure of owning original art, instead of just visiting it.



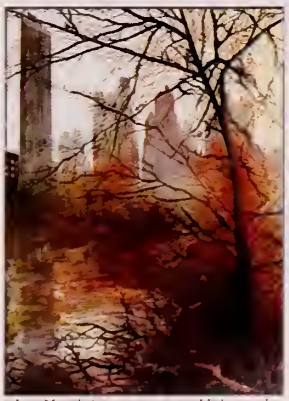
Irene Awret's *Mother and Child*, original lithograph. Signed limited edition of 150.



Thom de Jong's *Sunsit*, original etching. Signed limited edition of 125.



Nathalie Chabrier's *Place Furstemberg*, original lithograph. Signed limited edition of 250.



Jose Marti's *Cityscape*, original lithograph. Signed limited edition of 225.

Original print collectors group, Ltd.

215 LEXINGTON AVE., DEPT NH-32, NEW YORK 10016

PLEASE SEND ME YOUR FREE COLOR CATALOGUE WITHOUT OBLIGATION.

NAME _____
PLEASE PRINT

ADDRESS _____

CITY _____ ST _____ ZIP _____

© 1981 OPCG, LTD

Why our survival depends on theirs



So Remorseless a Havoc

Robert McNally

Passionate, moving, and beautifully written, SO REMORSELESS A HAVOC thoroughly details the evolution, physiology, instincts, and migratory patterns of whales and dolphins, the latest theories on the nature of their intelligence, and their significance in man's art, mythology, and literature. Illustrated throughout with photos, diagrams, and line drawings.

"Undoubtedly one of the best books about whales and dolphins and their fate at human hands that I've ever read."—*Farley Mowat*

"Excellent....I couldn't have stopped reading, even if I had wanted to."
—Roger Caras

Available at bookstores, or from NH 981
Little, Brown Distribution Center
200 West Street, Waltham, Mass. 02154

Please send me _____ copies at $13.95 each (562-920) of SO REMORSELESS A HAVOC

☐ I enclose a check or money order payable to Little, Brown and Company in the amount of $_____ (including $.50 for postage and handling Calif., N.Y., Mass. residents include sales tax.)

Charge my
☐ American Express ☐ Visa ☐ MasterCard
Account Number_____
*_____ Expiration date_____

Signature_____

Name_____

Address_____

City_____

State_____ Zip_____

*Please enter 4-digit number to left of your name (MasterCard only)

turn in April and May, a modest decline in kill numbers in the spring would not be surprising, and tallies for many species collected at the WCTV tower during the years from 1955 to 1980 conform to this general expectation. For example, 353 prairie warblers were killed in the spring compared with 533 killed in the autumn. For many species, the disparity between spring and fall mortality is more striking, and many are grossly overrepresented in fall collections. These include the magnolia warbler (519 of 520 total kills occurred in the fall), blackburnian warbler (374 of 374), chestnut-sided warbler (483 of 483), bay-breasted warbler (466 of 466), ovenbird (811 of 834), brown thrasher (277 of 290), veery (1,018 of 1,114), song sparrow (271 of 274), and white-throated sparrow (512 of 551). A few species, on the other hand, have been found more frequently in spring than in fall (blackpoll warbler, 158 versus 5; green heron, 27 versus 7).

Some of these differences probably reflect seasonal differences in routes and migration behaviors. The autumn route of the blackpoll warbler is largely across the open Atlantic Ocean, where prevailing winds help carry the birds to their winter homes in South America; the spring route is primarily through the Caribbean and peninsular Florida. Many other species, in contrast, pass through north Florida in large numbers in the fall on their way to Central and South America. These species, along with those that are winter residents near the tower, show up in the autumn kills. In the spring, some of the long-distance migrants fly to the west of WCTV. Other species seldom found in the spring kills, such as winter-resident sparrows and some migrants that fly at night in the fall, are thought to migrate northward during daylight hours.

A few species, most notably cedar waxwings and red-winged blackbirds, show peak WCTV tower mortality in the winter months of December, January, and February. The cedar waxwing is a winter wanderer in northern Florida, and red-wings maintained a winter roost near the tower for many years. June is consistently the month of lowest WCTV tower mortality. Over the years about 42,000 tower kills have been counted by the Tall Timbers staff, but only 28 individuals died in June.

Firm conclusions about the relative abundances of migrating species cannot be drawn on the basis of tower kill records alone because many factors affect the results. Early fall migrants such as Louisiana waterthrushes and orchard orioles, for example, are poorly represented at the WCTV tower probably because of the lower frequency and reduced severity of cold fronts in late July and August. A particularly strong front coinciding with a major wave of migrants may also produce potentially misleading statistics. On the night of October 8, 1955, about 2,000 palm warblers died at WCTV. This kill is the largest for a single species ever recorded at WCTV, yet the palm warbler is not otherwise particularly abundant in fall collections.

Information from tower kills is most valuable when compared and evaluated with data from other sources, such as those derived from fieldwork. For example, in the southeastern United States, yellow-billed cuckoos appear much more frequently during spring migration than do black-billed cuckoos. This field observation is supported by the tower kill results: on the average, about twenty yellow-bills are killed per year compared with about two black-bills. Sometimes, however, the data conflict. Tower results argue that the peak of yellow-billed cuckoo spring migration is the middle of May, much later than field observations would predict. This apparent contradiction has been explained. Some yellow-bills do arrive in early April and make themselves known by their distinctive call notes. But many more birds, traveling at night and formerly unnoticed, continue to pass through until late May, well after resident cuckoos have fledged young. The WCTV study has also increased our knowledge about the clay-colored sparrow, a species seldom observed in the field and presumed rare in Florida and nearby states. Six specimens have been recorded at the tower, showing that while the species is rare, it does pass through the area regularly.

Tower kills make possible the accurate determination of the sex and age classes of migrants, sometimes with unexpected results. At WCTV, female ruby-crowned kinglets are significantly more abundant than males. Females of this species are now believed to winter farther south in the United States than males. This behavior could have evolved in response to selection pressures favoring early arrival of males on choice, northerly breeding grounds in spring; it would also lessen intersexual competition during the winter.

Sometimes, the various age classes of a given species occupy largely different wintering grounds. Many autumn birds



Yours to keep... Photographer's Handbook... when you examine *Color*, free, for 10 days.

LIFE library of photography
Each volume features:
handsome, hardbound
9¼" x 9⅜" format;
approximately 200
pages, with index.

Natural History

Yes, I would like to examine *Color.* Please send it to me, along with the illustrated *Photographer's Handbook*, for 10 days' free examination, and enter my subscription to the *Revised LIFE LIBRARY OF PHOTOGRAPHY.* If I decide to keep *Color,* I will pay $12.95 ($14.95 in Canada) plus shipping and handling. I then will receive future volumes in the *Revised LIFE LIBRARY OF PHOTOGRAPHY* series, shipped one volume at a time, approximately every other month. Each is $12.95 ($14.95 in Canada) plus shipping and handling and comes on a 10-day free-examination basis. There is no minimum number of books that I must buy, and I may cancel my subscription at any time simply by notifying you. If I do not choose to keep *Color,* I will return it within 10 days, my subscription for future volumes will be canceled, and I will be under no further obligation. The illustrated *Photographer's Handbook* is mine to keep without obligation.

Name _____ (please print)

Address _____ Apt.

City _____ State or Province _____ Zip Code

Zip or Postal Code _____ DEAGY1

All orders subject to credit approval.
Canadian respondents: Mail card in an envelope.

NO POSTAGE
STAMP
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD

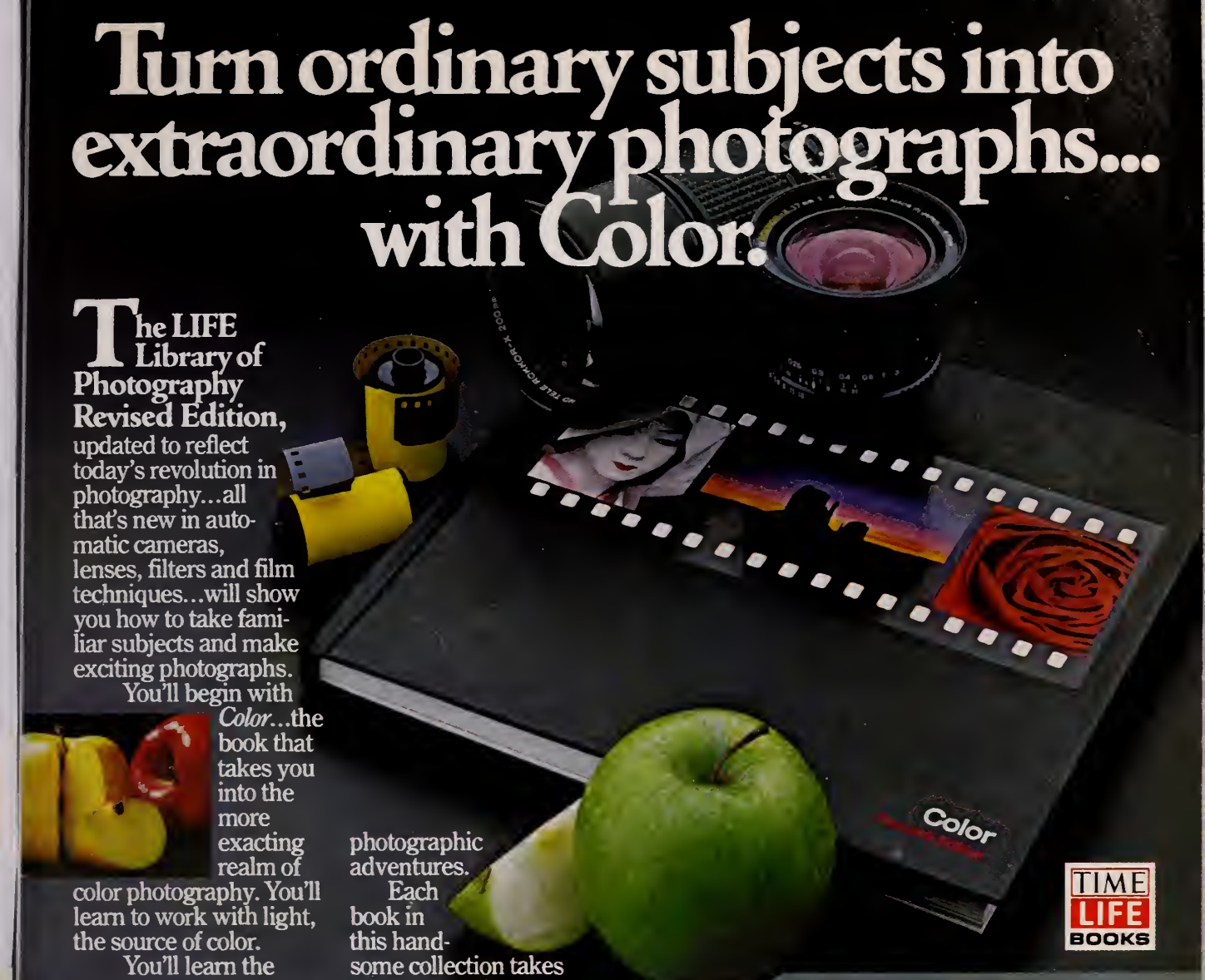
First Class Permit No. 22 Chicago, Illinois

Postage will be paid by

TIME
LIFE
BOOKS

Time & Life Building
541 North Fairbanks Court
Chicago, Illinois 60611

Turn ordinary subjects into extraordinary photographs... with Color.



The LIFE Library of Photography Revised Edition, updated to reflect today's revolution in photography...all that's new in automatic cameras, lenses, filters and film techniques...will show you how to take familiar subjects and make exciting photographs.

You'll begin with *Color*...the book that takes you into the more exacting realm of color photography. You'll learn to work with light, the source of color.

You'll learn the rules. And how to break them. From professional photographers like Haas, Eisenstadt and Porter. You'll learn how to take a blurry picture...to capture reflected light for unusual effects...to shoot in the fog, snow or rain...to use light available at different times of day... to diffuse light for beautiful still lifes...to use light to capture emotions in a human face. And much more.

Color is only the first in a series of photographic adventures.

Each book in this handsome collection takes you into a different area of photography... *Photographing Nature, Photographing Children, Travel Photography...* with brilliant photos, demonstration and step-by-step instruction.

Examine *Color,* free, for 10 days! Enter the exciting photographic world of the '80s and beyond.

If card is missing, write to: TIME-LIFE BOOKS, Time & Life Building, Chicago, IL 60611.



TIME LIFE BOOKS

For you...FREE from TIME-LIFE BOOKS... Photographer's Handbook.

68 pages of photographic tips and guidelines. Up-to-date for today's cameras. Take it wherever you and your camera go. It's yours to keep just for examining *Color.*





LIFE

LIFE LIBRARY OF PHOTOGRAPHY

©1981 TIME-LIFE BOOKS INC

Time-Life Books, Time & Life Bldg., Chicago, Ill. 60611

Yes, I would like to examine *Color.* Please send it to me, along with the illustrated *Photographer's Handbook,* for 10 days free examination, and enter my subscription to the *Revised LIFE LIBRARY OF PHOTOGRAPHY.* If I decide to keep *Color,* I will pay $12.95 ($14.95 in Canada) plus shipping and handling. I then will receive future volumes in the *Revised LIFE LIBRARY OF PHOTOGRAPHY* series, shipped one volume at a time, approximately every other month. Each is $12.95 ($14.95 in Canada) plus shipping and handling and comes on a 10-day free-examination basis. There is no minimum number of books that I must buy and I may cancel my subscription at any time simply by notifying you. If I do not choose to keep *Color,* I will return it within 10 days, my subscription for future volumes will be canceled, and I will be under no further obligation. The illustrated *Photographer's Handbook* is mine to keep without obligation.

Name _____ (please print)

Address _____ Apt _____

City _____ State or Province _____ Zip or Postal Code _____

All orders subject to credit approval.

DEAGY1

passing the WCTV tower are trans-Gulf migrants about to embark upon a nonstop flight to Central America. To the east in central peninsular Florida, the WDBO tower, also extensively monitored, is in the flight path of many circum-Gulf migrants: those that will fly directly to South America or island hop through the West Indies. In a comparison of autumn kills at the WCTV and WDBO towers, fourteen species were observed to have significantly different age-class ratios. Out of a total of 2,410 common yellowthroats, for example, adults constituted 29 percent of the kills at WCTV and 64 percent of the kills at WDBO. The comparison was based on data from two different time periods because figures were not available for overlapping years, but our experience has been that mortality patterns do not vary considerably from year to year. The evidence suggests, then, that the two towers may well be sampling different age cohorts of migrants on their way to separate wintering areas.

Whatever the sex or age, almost all birds killed at towers are nocturnal migrants since diurnal migrants easily avoid collision with communication towers. The food habits of a species appear to be important in determining the time of migration flights. For songbirds that forage on the ground or in wooded areas and rely on daylight to find prey, migration flights occur primarily at night during the normal sleep period. Thus these birds avoid what would otherwise be at least a 36-hour fast (from the night preceding a daytime flight through the following night). Species that normally feed on the wing during the day tend to be diurnal migrants, simply feeding as they travel.

Most sparrows, warblers, vireos, kinglets, cuckoos, wrens, thrushes (except the eastern bluebird), and mimic thrushes are nocturnal migrants, and all of these groups are well represented in the WCTV morgue. Waterfowl and shorebirds, some of which migrate at night, are rare at WCTV, but this may be partly because the tower is not located on a major flyway. Hawks, swifts, and swallows—familiar diurnal migrants—are represented by a total of only fifty-four corpses in twenty-six years at WCTV, and some of these deaths may have occurred during crepuscular flights. Several of the findings have been a surprise. Eastern kingbirds and American goldfinches are common migrants at Tall Timbers but are rarely found among the tower kills. Perhaps they migrate primarily during the day. And although cardinals in the Southeast are generally thought to be nonmigratory, the species is apparently a common night migrant at Tall Timbers, judging by the fifty-four specimens recovered between 1955 and 1980.

The WCTV tower returns suggest that species occasionally migrate in large flights. On May 2, 1964, 104 gray-cheeked thrushes were picked up at the base of the tower. This represented well over half the total gray-cheek kills recorded in the first eleven years of the study. On October 5, 1957, 126 gray catbirds were found at the tower. The same night brought down 54 summer tanagers, 163 American redstarts, 194 hooded warblers, and about 50 northern waterthrushes. Seventy-six prairie warblers were tallied on August 20, 1957, and the record kill of about 2,000 palm warblers in 1955 has already been mentioned.

Red-eyed vireos, by far the most abundant of the kills at WCTV and perhaps the most common species in all tower kills, account for about 17 percent of total deaths in the Tall Timbers study. Average mortality at this tower alone is about 286 birds per year, suggesting that the total slaughter of red-eyed vireos at all towers must be enormous. In contrast, a number of species (including the double-crested cormorant, horned grebe, great horned owl, and white ibis) have been recorded at the tower only once, but undoubtedly the most unusual casualty was a black-capped petrel found on September 11, 1964. This normally oceanic bird had apparently flown inland with the eye of a hurricane, only to succumb to a steel pillar.

Despite the huge number of specimens of all sorts collected in this 26-year study, only two birds carried bands: a brown thrasher, picked up on October 19, 1966, and banded on May 23, 1964, at New Brunswick, New Jersey; and a veery, picked up on September 25, 1965, and banded on September 1, 1965, near Chestertown, Maryland.

The largest single night kill ever recorded at Tall Timbers occurred just one week after the survey was begun. On the morning of October 9, 1955, Stoddard arrived at the base of the first WCTV tower, a 673-foot-tall structure, to find the grounds littered with an estimated 4,000 to 7,000 dead and dying birds; only 1,988 specimens of 62 species were identified before the rest were lost to decomposition and scavengers. In 1960, the original tower was replaced by the present 1,010-footer, with twenty-one guy wires, three sets of blinking red lights, and twelve small nonblinking red lights. The taller tower has not increased the recorded number of tower kills, and since 1967, recoveries have actually gone down sharply. The lower tallies, however, are perhaps primarily due to a reduced program of scavenger control.

One of the most dramatic findings of the WCTV study concerns the profound influence of predators and scavengers at the tower. If left unchecked, predators harvest large numbers of the birds killed and crippled during the night and early morning. The problem can hardly be overstated. On nights when there are massive kills, predators become supersaturated with food and do not severely influence census counts of tower kills, but on more usual migration nights, when perhaps five to one hundred birds are knocked down, scavengers may cause the disappearance of 50 to 100 percent of the kills before a tally can be made. The Tall Timbers staff has conducted many studies to document predator influence on counts. One night, for example, sixty experimentally marked corpses were scattered about the tower; by early morning all had disappeared. Many specimens vanish without a trace, but others leave "feather puddles" as evidence of the deed. The perpetrator may also leave clues to its identity—pellets, scats, feathers, tracks, scents, or partial prey remains.

We believe that entire predator–scavenger communities may develop around productive towers. The WCTV ornithologists have had to contend with a wide variety of competitors, including feral cats and dogs, escaped hogs, opossums, raccoons, bobcats, foxes, and skunks. Two of the more unusual scavengers observed at the tower were a toad found trying to swallow a dead bird and a cotton rat surprised while chewing on a ruby-crowned kinglet. Loggerhead shrikes frequently add WCTV birds to their larders, impaling them on barbed-wire fences at the tower site, and flocks of crows search the grounds each morning. Earwigs, yellow-jacket wasps, and a species of gray garden slug, *Deroceras laeve,* often feed on the dead birds. The eight species of ants that eat the tower birds, reducing them to a pile of feathers and bones in just a few hours, can be especially annoying when museum specimens are desired because an ant-infested bird may at first sight look intact and un-

The Onkyo TA-2050.
It will elate you, enfold you, exhilarate and enrich you.



The Onkyo TA-2050 is the most exciting stereo cassette tape deck in its price range. Nothing else provides the brilliant purity of its sound, or gives you so much control over the quality of your recording and playback.

The Onkyo TA-2050 provides all the features you'd want in a precision tape deck . . . and more. Onkyo's exclusive Accu-Bias system lets you "fine tune" your recording bias to customize sound. Peak reading meters (with decay) let you set more precise recording levels. Fade out/fade in controls, record/mute controls, and soft-touch switches with IC-logic . . . let you edit more professionally. Memory-stop/memory-play . . . remote control and timer/mode capability . . . 2-motor direct drive precision . . . and full metal tape compatibility . . . are just a few of the other important features the TA-2050 offers.

The Onkyo TA-2050 is a tape deck you can grow with. Hear it now at your Onkyo dealer.

Onkyo USA Corporation, 42-07 20th Ave., Long Island City, N.Y. 11105. (212) 728-4639 ONKYO

touched. The most troublesome scavengers at WCTV, however, are great horned owls. In an early report, Stoddard wrote: "As far as Horned Owls are concerned we are now reconciled to the fact that we will have to fight them every Spring and Fall migration for our share of the frequent kills. As we remove one owl, another soon appears and rather quickly learns when and where to look for dead birds."

The scavenger problem at WCTV became so severe that Stoddard and Robert A. Norris, who joined the project in 1962, reluctantly instigated various means of predator control. Owls, the primary target, were trapped and transplanted to other areas, and a few particularly wary offenders had to be killed. Some of the dead owls were prepared as scientific skins; the plumages of others were presented to Indian tribes of the Southwest for ceremonial use. One horned owl, trapped and banded at WCTV on July 15, 1974, was released in a national forest more than twenty miles south of the tower. It was retrapped at the same spot on the tower grounds on October 5, 1977, an unusual instance of homing by this species. Predator control was largely discontinued in 1966, with the result that total recoveries of WCTV tower kills have dropped dramatically. At man-made structures elsewhere, other scavengers, such as gulls, coyotes, and rats, probably cause consistent gross underestimates of total bird mortality. In Tennessee, even box turtles have been seen eating tower-killed birds.

In the early days, with or without competition from scavengers, the WCTV survey was hampered because the tower grounds effectively hid most of the kills. Small birds are extremely difficult to find in anything but the shortest grass, and most of the grounds were covered by thick weeds, with the remainder planted in corn, sweet potatoes, and other row crops. After the first year, however, twenty acres under the tower were disked and sown with grass; later, the area was expanded to thirty-four acres. Now maintained for the express purpose of facilitating kill recovery, this grassy area requires repeated use of a seven-foot, tractor-drawn mower for ten months of the year. One reason the serious threat that towers pose to migrants generally goes unrecognized is that most carcasses are not likely to be discovered unless the area is fastidiously maintained.

Probably the single worst avian mortality reported at a communication tower occurred during the nights of September 18 and 19, 1963, when an estimated 30,000 birds were killed at a TV tower in Eau Claire, Wisconsin. In 1975, there were 7,800 radio and 950 TV stations in the United States, and their cumulative effect is surely far from trivial. One estimate is that in the United States alone, more than one million birds die annually in accidental collisions with towers. Transmitting towers, however, are not the only man-made obstacles to avian migration. Lighthouses, chimneys, cooling towers, buildings, telephone and power lines, and public monuments contribute to the toll. A recent compilation found more than 1,040 references relating to mass avian mortality at such structures, and these may represent only a minute fraction of actual incidents. The Washington Monument in the nation's capital was the site of several reported kills in the late 1930s. For many years the Empire State Building in downtown New York used to kill large numbers of birds, attracted by a powerful fixed beam on top of the building and later by the intense glow of floodlights. Efforts are now made to have the floodlights turned off during overcast migration periods. On the night of September 27, 1962, about 6,000 birds met their death at the ceilometer of an Air Force base in San Angelo, Texas. Another 2,000 birds died on September 30, 1973, at a 1,000-foot smokestack in Chesire, Ohio. The Toronto-Dominion Center in Canada and a downtown office complex in Atlanta, Georgia, report frequent kills. The list goes on. Incidents of birds killed by striking windows or overhead wires have been less frequently reported, but investigators have estimated that these structures may cause even greater mortality.

The reasons so many migrants collide with transmitting towers and other tall structures remain a partial mystery. One theory is that transmitting towers, acting like giant rods, alter the electric field that surrounds them and somehow affect birds' navigational ability. This hypothesis, however, cannot be applied to lighthouses, ceilometers, or other obstacles that also act as death traps, and a more likely candidate for the most important factor in migration disasters appears to be the lighting condition. Bright lights are alluring to birds, particularly on cloudy, drizzly nights. In 1885, ornithologist William Brewster described the effect at the Point Lepreau Lighthouse on the Bay of Fundy, New Brunswick.

> As soon as the sky became overcast small birds began to come about the light [and] with the advent of fog they multiplied tenfold in the course of a few minutes. For the next hour from 30–100 were constantly in sight, and from one to eight to ten dashing at the lantern.... About 20% struck so forcibly as to injure themselves beyond hope of recovery, often, however, fluttering off the platform and down to the ground beneath.... At the height of the melee the scene was interesting and impressive beyond almost anything that I ever witnessed. Above, the inky black sky; on all sides, dense wreaths of fog scudding swiftly past and completely enveloping the sea which moaned dismally at the base of the cliffs below; about the top of the tower, a belt of light projected some 30 yards into the mist by the powerful reflectors; and in this belt swarms of birds, circling, floating, soaring, now advancing, next retreating, but never quite able, as it seemed, to throw off the spell of the fatal lantern.

An increased understanding of the conditions favoring avian mortality has led to some improvements in lighting design. In Great Britain, kills at one lighthouse have been drastically reduced by replacing revolving white beacons with flashing bluish lights. The substitution of rotating- for fixed-beam ceilometers in the early 1960s apparently all but eliminated kills at these installations. Few hard data are available as to whether alterations in lighting conditions at communication towers successfully reduce kills. The lights on towers have historically been red and white, suggesting that experiments with different wavelengths, intensities, and flash rates of lights may be fruitful. Any changes in lighting design cannot, of course, compromise the primary function of the lights—safety in human air navigation.

If there is a happy note on which to close a morbid topic, it must surely be the productive use made by scientists of the WCTV tower kills. In an age all too often characterized by short-term ecological studies, the WCTV study is unusual for its longevity. In the years ahead, the unfortunate birds that collide with the tower and wind up in the Tall Timbers freezer will continue to provide valuable information about avian migration.

John C. Avise is associate professor of genetics in the Department of Molecular and Population Genetics at the University of Georgia. Coauthor Robert L. Crawford is a curator and ornithologist at Tall Timbers Research Station in Tallahassee, Florida.

Choose one of these five works and save up to $216.15

You simply agree to buy 4 books within the next two years.



The Compact Edition of The Oxford English Dictionary

The "most complete, most scholarly dictionary of the English language"—*The Christian Science Monitor.* Through photo-reduction, the original 13-volume set has been reproduced in this two-volume Compact Edition. Magnifying glass included.

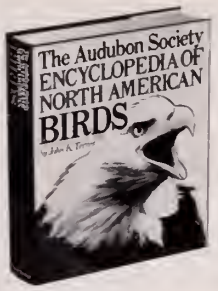
$125.00 Publisher's price
-$105.05 Your savings
$ 19.95 Book-of-the-Month Club price



Jefferson and His Time

The landmark six-volume set that is "a masterly achievement of scholarship, the finest biography of Jefferson we have or are likely to have and a monumental triumph of the senior American historian"—*The New York Times Book Review.*

$109.90 Publisher's prices total
-$ 94.90 Your savings
$ 15.00 Book-of-the-Month Club price



The Audubon Society Encyclopedia of North American Birds

The first one-volume encyclopedia to provide comprehensive information about *all* the birds that nest or have been sighted in North America. 6000 alphabetical entries, 875 color photographs, 800 drawings.

$60.00 Publisher's price
-$50.00 Your savings
$10.00 Book-of-the-Month Club price



The Story of Civilization by Will and Ariel Durant

For almost half a century, Will and Ariel Durant have been tracing the continuity of world history—the religions and philosophies, the political and economic tides, the arts and sciences, the customs and conquests—to show the foundations of society today. Now complete, the Durants' 11-volume illustrated masterwork is history come alive in all its dimensions. The enormous scope of the work covers ancient and recent civilization, including Oriental as well as Western history. A Book-of-the-Month Club exclusive for close to 50 years, it is both a reference work of undisputed authority and a lively portrait of the countless rulers and leaders who have shaped the course of human events. A magnificent centerpiece for any home library.

$241.10 Publisher's prices total
-$216.15 Your savings
$ 24.95 Book-of-the-Month Club price



Wildlife Habitat Series

Six volumes from the award-winning series: wildlife of the deserts, mountains, islands, oceans, forests and rivers. More than 200 color photographs in each volume, along with maps, appendix and detailed glossary. A beautiful addition to the home library.

$113.70 Publisher's prices total
-$ 95.75 Your savings
$ 17.95 Book-of-the-Month Club price

Prices shown are publishers' U.S. prices. Outside the U.S., prices are generally somewhat higher.

Benefits of Membership. Membership in the Book-of-the-Month Club begins with your choice of the extraordinary works offered here. Because our prices are generally lower than the publishers', you will save on works such as these throughout your membership as well as on the finest new fiction and nonfiction titles. In fact, the longer you remain a member, the greater your savings can be. Our Book-Dividend® plan, for which you become eligible after a brief trial enrollment, offers at least 70% off the publisher's price on art books, reference works, classics, books on cooking and crafts, literary sets and other contemporary works of enduring value. Nevertheless, all Book-of-the-Month Club books are equal in quality to the publisher's original; they are not condensed versions or cheaply made reprints.

As a member you will receive the *Book-of-the-Month Club News*® 15 times a year (about every 3½ weeks). Every issue reviews a Main Selection and 150 other books that we call Alternates, which are carefully chosen by our editors. If you want the Main Selection, do nothing. It will be shipped to you automatically. If you want one or more Alternates—or no book at all—indicate your decision on the Reply Form and return it by the specified date. *Return Privilege:* If the *News* is delayed and you receive the Main Selection without having had 10 days to notify us, you may return it for credit at our expense. *Cancellations:* Membership may be discontinued, by either you or the Club, at any time after you have purchased 4 additional books. Join today. With savings and choices like these, no wonder Book-of-the-Month Club is America's Bookstore.®

Book-of-the-Month Club, Inc., Camp Hill, Pennsylvania 17012 **A113-9**

Please enroll me as a member of Book-of-the-Month Club and send me the work I have checked below, billing me for the appropriate amount, plus shipping and handling charges. I agree to buy 4 books during the next two years. A shipping and handling charge is added to each shipment.

CHECK ONE BOX ONLY

- ☐ 912. Compact OED **$19.95**
- ☐ 913. The Story of Civ. **$24.95**
- ☐ 934. Jefferson & His Time **$15**
- ☐ 936. Wildlife Series **$17.95**
- ☐ 937. Audubon Encyclopedia **$10**

Mr.
Mrs. _____ **I-61**
Miss (Please print plainly)

Address _____ Apt _____

City _____

State _____ Zip _____

BOOK-OF-THE-MONTH CLUB®
America's Bookstore® since 1926

Quaggas, Coiled Oysters, and Flimsy Facts

False views are fun to disprove, but a false fact may become a long-lived burden for science

by Stephen Jay Gould

As Darwin cataloged cases of striped horses and asses to illustrate a common ancestry with zebras, he inevitably encountered one of the most famous animals of nineteenth-century natural history—the Earl of Morton's mare. Darwin wrote in the *Origin of Species:* "In Lord Moreton's [*sic*] famous hybrid from a chestnut mare and male quagga, the hybrid, and even the pure offspring subsequently produced from the mare by a black Arabian sire, were much more plainly barred across the legs than is even the pure quagga."

The quagga, a zebra with stripes restricted to its neck and forequarters, is now extinct. It was not thriving in the early nineteenth century either, when the good Earl hoped to save the species by domesticating it. He was able to procure a male for his noble experiment but could never obtain a female. So he bred his male quagga with "a young chestnut mare of seven-eighths Arabian blood," and obtained a hybrid with "very decided indications of her mixed origin." Nothing surprising so far.

But the disappointed Lord Morton, unable to find more quaggas, sold his Arabian mare to Sir Gore Ouseley, who proceeded to breed her with "a very fine black Arabian horse." When Lord Morton visited his friend and viewed the two offspring of pedigreed Arabian parents, he was astonished to note in them what he took to be a "striking resemblance to the quagga." Somehow, the quagga father had influenced subsequent offspring sired by other males years after his permanent departure from the life of Lord Morton's mare. How could such an influence be maintained long after physical contact had ceased?

Lord Morton's mare represents the most celebrated, but by no means the only, case of a phenomenon that German biologist August Weismann later named "telegony," from Greek roots meaning "offspring at a distance," or the idea that sires could influence subsequent progeny not fathered by them. Since the supposed phenomenon turned out to be an illusion, telegony now reposes as one more forgotten item on history's ash heap, and neither Lord Morton nor his mare retain any notoriety today.

But historian of science Richard W. Burkhardt, Jr., who recently wrote an excellent article on the history of telegony in general and Lord Morton's mare in particular (*Studies in History of Biology,* vol. 3, 1979, pp. 1–21), has demonstrated that telegony was once a major subject for research and "inspired the most extensive work in experimental animal breeding conducted in Britain between Darwin's death in 1882 and the rediscovery of Mendel's law in 1900." Darwin himself was a major supporter of telegony.

If the supposed causes of telegony are a bit mysterious, Darwin's reasons for espousing the idea may seem equally difficult to fathom. After all, he first discussed the progeny of Lord Morton's mare in a different context that implied an explanation opposed to telegony. As I wrote in my last two columns (this, I promise, is the last word for a while on zebra stripes), Darwin had cataloged all cases he could find of asses and true horses with stripes. And he had uncovered a bounty. He used his striped horses as an effective argument for evolution: If God had created true horses, asses, and zebras as separate forms, why should species that normally do not have stripes develop them quite frequently? Does not this latent tendency for striping in all horses (permanently actualized only in zebras) indicate common descent? In this context, why did Darwin later implicate the previous quagga sire in the striping of subsequent offspring from Lord Morton's mare? In this first discussion,



A quagga

from the *Origin of Species,* Darwin only wanted to prove that true horses and asses can develop stripes *without* any zebra influence. As we shall see, this original explanation was apparently correct.

Burkhardt argues that Darwin changed his mind and supported telegony because it fit so well with the (ironically) "non-Darwinian" theory of heredity that he developed in 1868. Under this "provisional hypothesis of pangenesis" (as Darwin called it), all cells of the body produce tiny particles, called gemmules, that course throughout the body, gather in the sex cells, and eventually transmit the characters of parents to offspring. Since gemmules might be altered if the cells producing them are changed by the influence of environment or the activity of animals themselves, acquired characters can be inherited and evolution has an important Lamarckian aspect.

Telegony meshed well with pangenesis because gemmules included with the quagga's sperm would have remained in the body of Lord Morton's mare and extended their influence to her subsequent offspring. (Darwin even once speculated that gemmules passed in sperm might explain why some women grow to resemble their husbands. As to why so many people resemble their dogs, Darwin maintained a discreet silence.)

Telegony finally fell when a new theory of heredity rose to favor and excluded it. August Weismann, who championed the strict Darwinism of natural selection against all forms of Lamarckian inheritance (including Darwin's own pangenesis), argued for what he called "the continuity of germ plasm." He held that reproductive cells are completely isolated from the rest of the body and cannot be influenced by whatever forces mold and alter other organs and tissues. Acquired characters cannot affect the next generation because they cannot penetrate the "cas-



"They'll be back...
they forgot the Chivas Regal."

Chivas Regal • 12 Years Old Worldwide • Blended Scotch Whisky • 86 Proof. General Wine & Spirits Co., N.Y.



THE TROPICS IN DANGER

The JAGUAR is one of the many inhabitants of tropical rain forests—in fact, more than half of the world's plants and animals live in these forests.

If present trends continue 500,000 or more species will be extinct within the next 20 years. Most of these losses will occur in tropical rain forests.

Concerned people everywhere must band together to protect these vital resources.

RARE is a non-profit, volunteer based organization devoted to the protection of endangered plants and animals. RARE is doing all it can but WE NEED YOUR HELP TO PROTECT THE JAGUAR. Your contribution will help save this beautiful cat.

The "Jaguar" painting by Bonnie L. Marris is available in three 18x24 full color editions.

(1) Jaguar conservation poster with a contribution of $15.00.
(2) Signed and numbered print from the limited edition of 500, on 100% cotton stock, with a remittance of $125.00.
(3) Special remarqued edition of 250 prints with a donation of $175.00.

Please specify your choice and make checks payable to RARE, Inc.

RARE

Rare Animal Relief Effort, Inc.
c/o National Audubon Society
950 Third Avenue, New York, N.Y. 10022

Your generous contributions are deductible for Federal income tax purposes to the extent allowed by law.

ket" that holds reproductive cells and transmits itself in toto from generation to generation. (The fertilized egg, of course, is formed by the union of two reproductive cells. As it starts to divide, however, the nonreproductive cells form, eventually develop into the organism's body, and become rigidly segregated from the continuous lineage of germ cells. Telegony makes no sense because, even if they existed, male gemmules in a female's body could not get to the germ cells—unless, of course, they managed to reach the ovaries themselves and modify the immature ova.)

Telegony kicked about in scientific literature for seventy years, from Morton's note to the Royal Society in 1820 until Weismann's challenge. When Weismann proposed the continuity of germ plasm, telegony became a threatening anomaly demanding affirmation or rejection. Many tests were made, and telegony failed them miserably. In particular, J.C. Ewart, Regius Professor of Natural History at Edinburgh, tried to repeat Morton's own experiment. Since quaggas had joined *Eohippus* in the realm of departed horses, Ewart mated twenty mares of different races and breeds with a male Burchell's zebra. The first hybrid, born in 1896, had stripes as expected. Ewart then mated the mare with a second sire, an Arab stallion. Their offspring also had stripes, albeit faint, and telegony seemed vindicated. But Ewart knew that he needed controls and therefore bred the same Arab stallion to other mares that "had never so much as seen a zebra." The offspring of these matings were as richly striped as the foal from the mare that had previously mated with a zebra. Darwin had been right the first time. Stripes do not arise from a mysterious previous zebra influence; they represent a potential pathway of development for all horses.

I have not recounted this tale of telegony for its own sake, since antiquarian musings only excite professionals and trivia buffs. Rather, as Burkhardt emphasizes, the story embodies a larger, troubling, and important issue about the nature of fact in science. Telegony, so far as we can tell, was wrong; yet it remained in the literature as a pristine fact, largely unchallenged, for seventy years. In a reversal of the stereotyped scenario, where a single sturdy fact arises to destroy an entire edifice of theory, the "fact" of telegony came first, became entrenched, and was only seriously challenged when a theory—Weis-

High yields?

Yes.

Easy access?

Yes.

Free checks?

Yes.

And no penalties!

Start with just $2,500. You can add to your account at any time with investments as low as $100. And you're not locked into any time period. Your money is always available whenever you need it, with no penalty for withdrawal. For full details on this popular money market fund, mail coupon or call today.



Dreyfus Liquid Assets

2260109

For more complete information, including management fee charges and expenses, obtain a prospectus by sending this coupon. Read it carefully before you invest or send money.

Name_____

Address_____

City_____

State_____ Zip_____

0461

Post Office Box 600
Middlesex, NJ 08846

FOR A PROSPECTUS

Call toll free, day or night, 7 days a week

1-800-345-8501
Extension 461

In Pennsylvania
1-800-662-5180 Extension 461

ses·qui·cen·ten·ni·al



Webster's New Collegiate Dictionary.
It's where the words live.

For 150 years, G. & C. Merriam has been bringing the language to life and life to the language. Today, the best-selling Webster's New Collegiate offers 150,000 words, including 22,000 new entries. Get a taste of "Fast Food," feel an affinity for "Clone," and share in the celebration of our "Sesquicentennial." In 150 years, dictionary has never meant so much. Just $12.95, indexed. A gift of lasting value.

FROM MERRIAM-WEBSTER®

© G &C MERRIAM 1980



The 1982 Program

Stimulate your mind on a Questers nature tour. We search out the plants and animals, birds and flowers...and explore rain forests, mountains and tundra, seashores, lakes and swamps. There is ample time to photograph, absorb, reflect. Naturalist guides, small tour parties, first-class accommodations.

Worldwide Nature Tours
1982 Departures

The Americas

Everglades: 11 days, Apr. 8, Nov. 4 • Hawaii: 15 days, Feb. 14, Mar 21, Oct. 10, Dec. 19 • Alaska: 17 days, June 12, 26, July 10, 24, Aug. 7 • Pacific Northwest: 12 days, June 20, Aug. 1 • Superior Forest Canoe Trip: 9 days, July 10, Aug. 14 • Northwest Canada: 16 days, July 2 • Churchill: 11 days, July 17 • Newfoundland: 16 days, June 13 • Baja California: 11 days, Apr 16, Oct. 15 • Southern Mexico: 14 days, Feb. 14, Dec. 19 • Costa Rica & Panama: 16 days, Feb. 13, Nov 20, Dec. 18 • The Amazon: 17 days, Jan. 17, May 9, July 4, Aug. 8, Oct. 10, Nov 14 • Galapagos: 15 days, Jan. 28, Apr 22, July 15, Aug. 5, Oct. 28 • Peru: 23 days, July 17, Nov. 6 • Patagonia: 21 days, Nov 6 • Trinidad & Tobago: 11 days, Mar 8, Nov 8

Europe

Iceland: 16 days, June 11, July 2, Aug. 6 • Islands/Highlands of Scotland: 21 days, May 27, July 15, Aug. 19 • Switzerland: 17 days, July 16, Aug. 13 • Greece: 19 days, Mar. 29, Sept. 20 • Spain: 20 days, Apr. 16, Sept. 3.

Asia and Africa

Israel: 16 days, Mar. 15, Oct. 18 • The Himalayas: 23 days, Mar 18, Oct. 7 • India: 23 days, Jan. 30, Oct. 30, Nov. 27 • Sri Lanka: 18 days, Feb 19, Nov 19 • Kenya: 23 days, Feb. 4, July 22, Oct. 21 • Zimbabwe & Botswana: 19 days, July 8, Aug. 5

Australasia

Australia & New Zealand: 30 days, Feb. 13, Oct. 2 • New Zealand & the Milford Track: 22 days, Feb. 12, Nov. 12 • The Complete Australia: 35 days, Sept. 3

To learn more, write requesting the 1982 Directory of Worldwide Nature Tours. Indicate if you are interested in any particular tour and we will send the corresponding Detailed Itinerary.



QUESTERS
Questers Tours & Travel, Inc.
Dept. NH, 257 Park Avenue South
New York, NY 10010 • (212) 673-3120

mann's continuity of germ plasm—rendered it anomalous. Burkhardt writes that in the usual model "a long-accepted theory is toppled by a newly discovered, apparently anomalous fact. In the case of telegony, in contrast, a long-accepted 'fact' was discredited when confronted with a new, apparently contradictory theory."

In part, Burkhardt suggests, telegony gathered favor because it fit well with a variety of nineteenth-century assumptions, ranging from the "natural" dominance of males over females to support for separation of races by the argument that sexual contact with a lower race might extend its baleful influence far beyond the immediate consequences of the act itself. In part, telegony simply wasn't controversial enough and nobody bothered to test Lord Morton's improbable assertion. When tested, telegony fell, and to this extent the usual model of science as objective experiment was vindicated. But another aspect of the conventional view did not apply: fact did not act as the cleansing broom for outmoded theory. Rather, a false "fact" endured for an uncomfortably long time until theory demanded its test. What does this story tell us about the relation of fact and theory in science and about the role of single, isolated facts in the first place? I will return to these generalities, but first, another and similar tale.

In 1922, British paleontologist A.E. Trueman published the most famous paper of our century on a supposedly unbroken lineage of evolving fossils. He argued that flat oysters had slowly evolved into coiled oysters of the genus *Gryphaea*. Although coiling was originally advantageous in raising the oysters above an increasingly muddy sea floor, the trend, once started, could not be halted. *Gryphaea* built one coiled valve and one flat valve lying like a cap atop its coiling partner. Eventually, the coil grew up and over the cap, finally pressing hard upon it. Unable to open its shell, *Gryphaea* perished, imprisoned in its own embrace.

When Trueman published his paper, most paleontologists were not Darwinians. The theory of orthogenesis, or "straight line" evolution forcing organisms along predetermined paths, was still popular. An inexorable trend that natural selection could not stop and that led to the demise of a lineage was an expected phenomenon. Thus, Trueman's story was not challenged by paleontologists, and like the zebra's impact on Lord Morton's mare, overcoiled

Do you have room in your home for three wise men? They are Plato, Aristotle, and Marcus Aurelius...three of the wisest, wittiest, most stimulating minds that ever lived.

They still live...in the Five Great Dialogues of Plato, the Meditations of Marcus Aurelius, and Aristotle's On Man in the Universe.

All three books (regularly $25.47) can be yours for only $1.00 as your introduction to the Classics Club.

The Classics Club is quite unlike any other book club.

The Club doesn't offer best sellers that come and go. Instead, it offers its members a chance to stay young through great books that will never grow old. These books include Utopia by Thomas More; the works of Shakespeare; Benjamin Franklin's Autobiography; Omar Khayyam's Rubaiyat; Walden by Thoreau; and other fresh, spontaneous, even outspoken works that stretch your mind and sweep away the mental cobwebs that hold back most men.

You never have to buy any of these books. (To force you to buy a classic would be barbaric.) As a member, take only those books you really want to own. And, at any time, you may cancel your membership, without penalty or hurt feelings.

The selections themselves are remarkable values. They're carefully printed on expensive paper stock. They're hard-bound in matched wheat-colored buckram, worked and stamped in the colors of crimson, black and gold. And through direct-to-the-public distribution, we are able to offer to our members these deluxe editions for only $8.49 each, plus shipping.

Interested? We'll send you the first three selections, Plato, Aristotle and Marcus Aurelius – all three for only $1.00 plus shipping.

We know what charmers these three wise men are. We're betting that you'll be so taken by them that you'll want to stay in the Club and meet some of their friends, including the greatest story tellers, philosophers, poets, and historians the world has ever known.

Don't send any money now. We'll bill you later. Just fill in the coupon below, now, while you're thinking about it and while the invitation still stands.

Mail coupon to The Classics Club, Roslyn, New York 11576.



LET THESE 3 WISE MEN INTO YOUR HOME.

LATER, YOU MIGHT LIKE TO INVITE THEIR FRIENDS.

THE CLASSICS CLUB ROSLYN, N.Y. 11576

Please enroll me as a member and send me at once Plato, Aristotle and Marcus Aurelius. I enclose *no money now*. After a week's examination, I will either keep my books and pay $1 (plus shipping) or return them. As a new member, I will get a complete list of titles from which to select the books I want. For each volume I choose, I pay only $8.49 (plus shipping). I may return any book, for full credit within 21 days and I may cancel my membership at any time. Note: Members accepted in U.S.A. and Canada only. Offer slightly different in Canada.

MR./MRS./MS. _____
(PLEASE PRINT) C02D4M

ADDRESS _____

CITY _____

STATE _____ ZIP _____ I-TR

THE OFFICIAL ROYAL WEDDING CROWN COIN

Electroplated in
PURE 24-KARAT GOLD



Actual Size

Exclusive Offer Only $5.

On July 29th, the wedding of the future King and Queen of England took place at London's famous St. Paul's Cathedral. To honor this historic event, The Royal Mint of England is minting a special legal tender Crown Coin. The Crown coin is the largest coin in England — heavier and larger than a United States Silver Dollar. This is the first time in England's long history that a Royal Wedding Crown coin has ever been issued. Crown coins are minted by The Royal Mint only for rare occasions and as such are sought after and hoarded by collectors in England for future generations. Truly a collector's coin of untold historic value, it will be cherished and valued for years to come.

The face of the coin bears the likeness of HRH Prince of Wales and Lady Diana Spencer, The reverse, the famous portrait of Her Majesty, Queen Elizabeth by Arnold Machin, which graces every coin currently circulating in England.

EXCLUSIVE OPPORTUNITY

You have an exclusive opportunity to acquire a limited number of these coins as a direct result of the special arrangements The Columbia Mint has made to make them available to collectors in the United States. The Royal Wedding Crown Coin, embellished in pure 24 Karat Gold—The Metal of Royalty—mounted in a protective serially numbered display wallet along with an historical account of the wedding, can be yours for just $5 each plus 50¢ postage and handling, but supplies are limited. Due to the limited supply, there will be a strict limit of (5) Crowns per order.

For faster service, credit card charge orders may call FREE 24 hours a day
Minimum order $10
800-228-5000

LIMITED AVAILABILITY — ACT NOW

The Royal Wedding Crown will only be minted this one time and never again. Therefore, you should not delay in placing your order. Only by doing so can you be assured of the right to own this historic and majestic beautifully electroplated Crown in pure 24-Karat Gold. Send your order today to The Columbia Mint, 905 Sixteenth Street N.W., Washington, D.C. 20006. But do it now as you may never have this opportunity again.

OFFICIAL WEDDING CROWN ORDER FORM

THE COLUMBIA MINT **104**
905 Sixteenth St. N.W., Washington, DC 20006

Please enter my order for_____(limit 5) OFFICIAL ROYAL WEDDING CROWN COINS electroplated in PURE 24-KARAT GOLD at $5.00 each plus 50¢ each for postage and handling. I understand that each Coin will be mounted in a protective serially numbered display wallet along with an historical account of the wedding. If I am not completely satisfied, I may return my coin(s) within 10 days for a refund of my purchase price.

☐ Enclosed is my remittance for $_____
☐ Charge $_____(Minimum charge $10) to my
☐ Visa ☐ American Express ☐ Mastercard
Card No _____Exp. Date_____
Signature _____
Name _____
Address _____
City, State, Zip _____
Please allow 4 to 6 weeks for delivery

Better Than Jogging



NordicTrack

Jarless Total Body Cardiovascular Exerciser Duplicates X-C Skiing for the Best Motion in Fitness

This revolutionary new exerciser duplicates the smooth, rhythmic, total body motion of X-C skiing for the most effective cardiovascular exercise obtainable. Uniformly exercises more muscles than any other exercise device. Makes high heart rates easy to obtain and keeps more muscles in tone. Also highly effective for weight reduction.

Completely jarless natural motion does not cause joint and back problems as in jogging or running. Arm and leg resistances are separately adjustable for maximum effectiveness. The NordicTrack uses no motors and folds compactly for convenience. Used in homes, businesses, and institutions. Our customers include Xerox Corporation, US Army, Penn State U and the YMCA.

For more info, call or write
PSI 124 L Columbia ct. Chaska, MN 55318
toll free 1-800-328-5888, MN. 612-448-6987



Send $3 for catalogue to Dept. NH-09
Box 31442, San Francisco, CA 94131
Boutiques: San Francisco, Palo Alto & Cupertino, CA

Gryphaea became established as a fact.

In the late 1930s, after a gestation of nearly one hundred years from Darwin's great insight and eighty years from its publication, natural selection finally triumphed as the accepted theory of evolutionary change, and *Gryphaea* became an anomaly. How could a lineage *actively* evolve itself to extinction if all evolutionary change is directed by natural selection and can, therefore, only occur in directions that adapt organisms to local environments? (Extinction based upon an inability to change rapidly enough in the face of environmental perturbation is another matter and perfectly orthodox in a Darwinian world.)

Darwinians reacted to *Gryphaea* in a variety of ways, but all were deeply troubled. Some, like J.B.S. Haldane, simply admitted puzzlement: "The exaggerated coiling of *Gryphaea* cannot at present be explained with any strong degree of likelihood." Others, like G.G. Simpson, tried to steer around the problem with faintly plausible, but evidently ad hoc suggestions: since overcoiling only affected the oldest, and probably postreproductive, individuals, it may even have benefited the population by clearing out the old codgers and making space for the young and vigorous. Yet, through all these efforts in salvaging natural selection, no one asked the more basic question, Is it even true in the first place? Overcoiling in *Gryphaea* had become a fact.

But it is not true; overcoiling in *Gryphaea* is as chimerical as the supposed influence of Lord Morton's quagga upon the subsequent progeny of his mare. In 1959, Anthony Hallam, now a good friend and professor of geology at Birmingham, but then a brash graduate student, wrote an iconoclastic paper with two controversial claims: first, that *Gryphaea* had not evolved from flat oysters at all, but had migrated into southern England from elsewhere; and second, that *Gryphaea* arrived in England as coiled as it would ever be—and that no trend to increased coiling within *Gryphaea* could be demonstrated at all. Hallam's conclusion scandalized many senior scientists who had known Trueman. H.H. Swinnerton, dean of British paleontology, wrote back in anger, accusing Hallam of both "sin" and "monstrous error," an odd pair of accusations for a scientific paper.

Twenty years later the dust has settled, and I do not think that anyone would now doubt Hallam's debunking. For Hallam's first claim—that *Gry-*

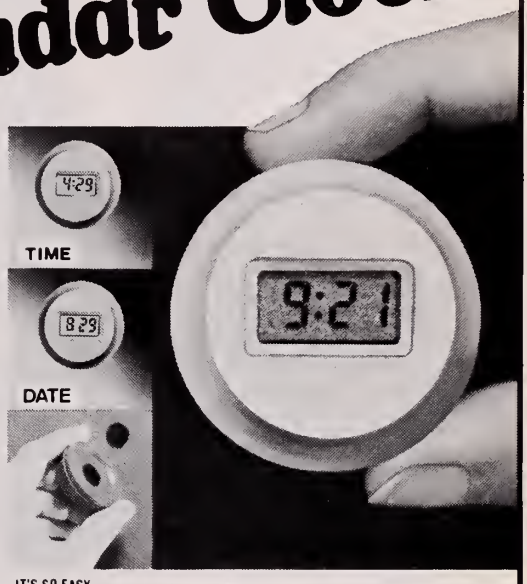
phaea did not evolve from flat oysters—H.B. Stenzel's impressive monograph (*Treatise on Invertebrate Paleontology,* Geological Society of America and University of Kansas Press, part N, vol. 3, 1971) has proved that the lineages of flat oysters (genus *Ostrea*) and coiled oysters (genus *Gryphaea*) have been separate from their first appearance, that *Gryphaea* is a bit older than *Ostrea,* and that coiled ancestors for Trueman's *Gryphaea* were living in Greenland before *Ostrea* ever appeared in England.

For his second claim—that *Gryphaea* did not increase in coiling during its evolution—I have reexamined all the published data and concluded that while *Gryphaea* did increase in body size, its degree of adult coiling remained constant. Ironically, this means that later *Gryphaea* were actually more loosely coiled than earlier specimens of the same body size, for coiling increases with growth, and if a larger adult descendant will reach the same intensity of coiling as its smaller adult ancestor, then the descendant's shell must be more loosely coiled when it is still a juvenile of the same size as its ancestral adult. (I have reprinted all major papers from the great *Gryphaea* debate in a volume entitled: *The Evolution of Gryphaea,* Arno Press, 1980.)

If Trueman's edifice toppled so easily, why was his "fact" accepted so readily in the first place? One might suspect that the overcoiling of *Gryphaea* had received lengthy and complex documentation, however unreliable it proved to be, and that Trueman simply snowed potential critics. Not at all. The original evidence was flimsy almost beyond belief, and this, to me, is the most curious aspect of the entire tale. In his 1922 paper, Trueman showed how most large adult *Gryphaea avoid* calamitous overcoiling by decreasing the tightness of their spiral late in growth.

Trueman's claim for overcoiling was based on a single specimen, the "type" (or name-bearing) specimen of the species *Gryphaea incurva.* I examined this specimen at the British Museum in 1971. At first glance, the coiled valve does seem to press hard upon the flat valve. But the specimen was recovered from very fine-grained muds of the same color as the shell itself. A bit of probing revealed—and X-ray photographs later confirmed—that the supposed "lock" upon the flat valve had not been formed by the coiled valve itself, but by mud that wedged its way

FANTASTIC
Sticks-Up Everywhere Calendar Clock



Displays hour & minutes with quartz crystal accuracy–

changes automatically every 2 seconds to show month & date!

IT'S SO EASY TO "STICK 'EM UP!"

• 1½" DIAMETER • ½" THICK • ½ OUNCE WEIGHT

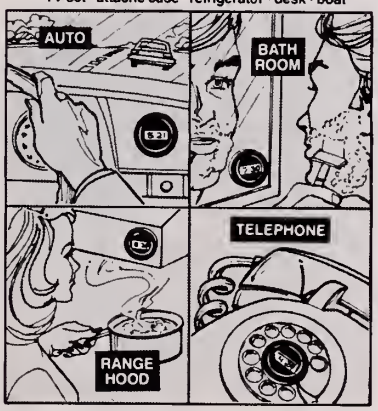
Fantastic Price Break
NOT ~~$19.95~~ NOT ~~$14.95~~

NOW ONLY $9.77

SAVE MORE! 2 for only $8.88 each.

- NO WINDING! NO PLUGS! NO BUTTONS TO PUSH!
- SPACE-AGE ACCURACY!
- BUILT-IN COMPUTER adjusts for long and short months!
- EASILY REPLACEABLE BATTERY (included) powers clock for one FULL YEAR!
- *SUPER-STICK, DETACHABLE FELT BACKING grips instantly to any surface, lets you STICK 'EM UP ANYWHERE!*
- CHOOSE FROM 3 DECORATOR COLORS—red, yellow or beige!

Use 'em everywhere to keep you on schedule:
•TV set • attache case • refrigerator • desk • boat



Now, at home, in the office, in your workshop or garage, have the TIME AND DATE always just a glance away—with these incredible LCD-DISPLAY CALENDAR CLOCKS!

And now, during this fantastic PRICE BREAK, order extra CALENDAR CLOCKS *AND SAVE EVEN MORE!*
SATISFACTION GUARANTEED or your money refunded in full (except postage & handling). RUSH YOUR ORDER TODAY!

Adam York/**UNIQUE** Products Co.
Hanover, PA 17331

SATISFACTION GUARANTEED—MAIL TODAY

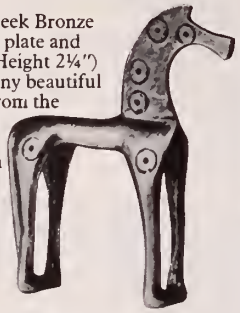
Adam York/UNIQUE Products Co., Dept. UZ-5723, 340 Poplar St., Hanover, PA 17331

☐ **YES!** Please send me one STICKS UP CALENDAR CLOCK #Z53D1D5B for ONLY $9.77 plus $1.25 postage & handling!
(Color choice: _____)
☐ **SAVE!** Send me 2 CALENDAR CLOCKS for ONLY $17.76 plus $2.25 postage & handling!
(Color choices: _____)
☐ **SAVE MORE!** Send me 3 CALENDAR CLOCKS for ONLY $24.88 plus $3.00 shipping & handling.!
(Color choices: _____)
☐ Check or money order enclosed for $_____.
(PA residents please add sales tax.)
CHARGE TO: ☐ American Express ☐ VISA
☐ Carte Blanche ☐ Diners Club ☐ MasterCard
Acct. # _____ Exp. Date _____

PRINT NAME _____
ADDRESS _____
CITY _____
STATE _____ ZIP _____
☐ Check here and send 50¢ for year's subscription to our full-color catalog of fine gifts (Z999995X). We ship within 48 hours; delays notified promptly. Delivery guaranteed within 60 days.

© Adam York/UNIQUE Products Co., 1981

Shop The Boston Museum of Fine Arts by Mail.



This striking Greek Bronze Horse with gold plate and antique finish (Height 2¼") is just one of many beautiful reproductions from the collections of the renowned Boston Museum of Fine Arts. Available September 1 through a new 32 page color gift catalogue.

☐ Yes, I would like the Greek Bronze Horse. Enclosed is $10.00 (plus $1.50 shipping and handling).

☐ Yes, I would like the Museum catalogue and all others through June, 1983. Enclosed is $1.00.

Name_____

Street_____

City_____ State_____ Zip Code_____

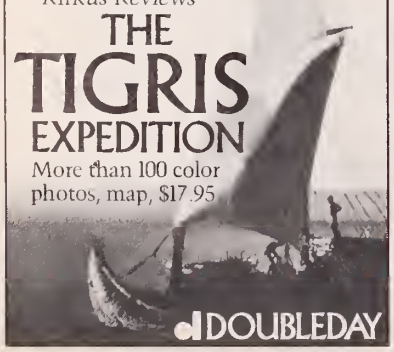
Mail to:
The Boston Museum of Fine Arts Shop
Dept. NH-19
P.O. Box 1044
Boston, MA 02120

DR. THOR HEYERDAHL in search of man's beginnings...

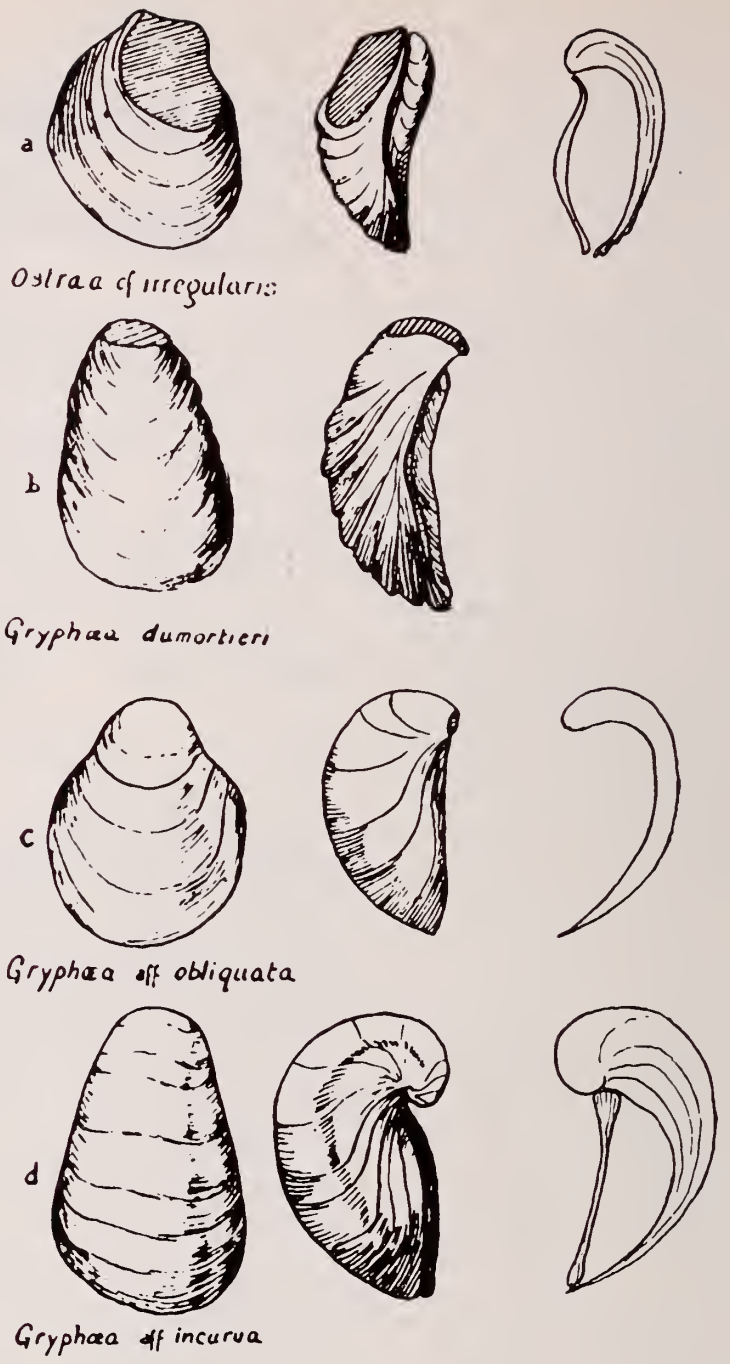
"Surpasses *The Ra Expeditions* or *Kon-Tiki*."—*Publishers Weekly*. For five months famed researcher, sailor and explorer Thor Heyerdahl traced the trade routes that flourished a thousand years before the birth of Christ, aboard a reed ship built after a pattern more than three millennia old. "Rewarding...an eye-witness passage into the dim past."
—*Kirkus Reviews*

THE TIGRIS EXPEDITION

More than 100 color photos, map, $17.95



DOUBLEDAY



Paleontologist A. E. Trueman illustrated the supposedly inexorable evolution of oysters of the genus Gryphaea *from flat* (a) *to coiled* (d) *in this drawing from a 1922 issue of* Geology Magazine.

into the space between flat and coiled valve, the space that allowed the shell to open, after the animal's death.

If telegony and overcoiling are false "facts," why did each command prestige and inspire no attempt at refutation for so long? I believe, first of all, that the reputation of false facts is bolstered by the naïve belief that facts are bits of unsullied information extracted from nature by an objective process of pure observation or by scientific inference. Facts arise in contexts of expectation, and both the eye and the mind are noto-

Explore...with the Natural Science Book Club

starting with any choice **for just $2.97 when you join.**

You simply agree to buy 3 more books—at handsome discounts—over the next 12 months.

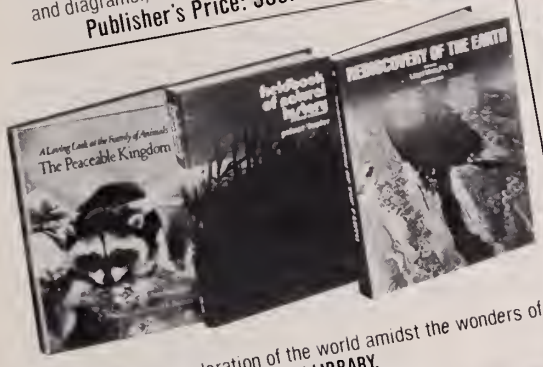
(values up to $75.00)



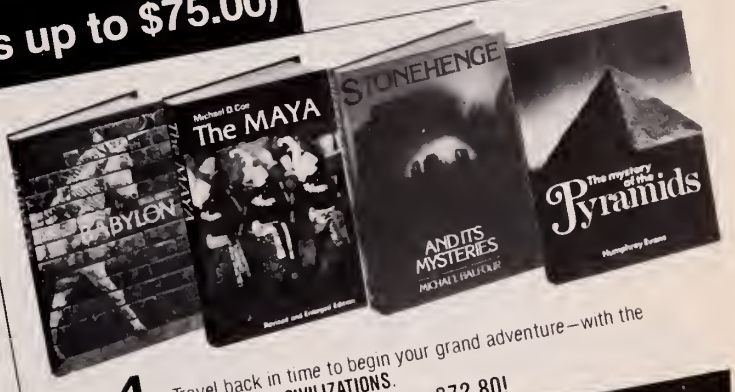
1. Begin building your science library with **VAN NOSTRAND'S SCIENTIFIC ENCYCLOPEDIA**—the most comprehensive reference work of its kind! (With thousands of photos and diagrams.)
Publisher's Price: $69.50!



2. Dig for clues to the world's greatest mysteries, beginning with the **ARCHAEOLOGY LIBRARY.**
Publisher's Price $69.90!



3. Start your exploration of the world amidst the wonders of nature—with the **NATURAL HISTORY LIBRARY.**
Publisher's Price: $74.95!



4. Travel back in time to begin your grand adventure—with the **LIBRARY OF ANCIENT CIVILIZATIONS.**
Publisher's Price: $72.80!



5. Voyage through the universe with **GALAXIES**, a stunning volume that Isaac Asimov calls "a very good candidate for the most beautiful book in the world."
Publisher's Price: $75.00!

MEMBERSHIP BENEFITS: In addition to getting either *Van Nostrand's Scientific Encyclopedia* or any one of the four other choices for only $2.97 when you join, you keep saving substantially on the books you buy. ● Also, you will immediately become eligible to participate in our Bonus Book Plan, with savings of 70% off the publishers' prices. ● At 3–4 week intervals (16 times per year) you will receive the Book Club News, describing the coming Main Selection and Alternate Selections, together with a dated reply card. ● If you want the Main Selection, do nothing and it will be sent to you automatically. ● If you prefer another selection, or no book at all, simply indicate your choice on the card, and return it by the date specified. ● You will have at least 10 days to decide. ● If, because of late mail delivery of the News, you should receive a book you do not want, we guarantee return postage.

Natural Science Book Club

Riverside, NJ 08075

I choose to start with:

- **Set #1** (00470-3) ☐
- **Set #2** (A-10130) ☐
- **Set #3** (10112) ☐
- **Set #4** (B-10107) ☐
- **Set #5** (50025) ☐

Please accept my application for trial membership and send me the selection I've checked at left, billing me only $2.97.

I agree to purchase at least three additional Selections or Alternates over the next 12 months. Savings range up to 30% and occasionally even more. My membership is cancelable any time after I buy these three books. A shipping and handling charge is added to all shipments.

No-Risk Guarantee: If you are not satisfied—for any reason—you may return your introductory books within 10 days. Your membership will be canceled and you will owe nothing.

Name _____

Address _____

City _____

State _____ Zip _____

(Offer good in Continental U.S. and Canada only
Prices slightly higher in Canada.)

4-AM6

L.L.Bean®
Outdoor Sporting Specialties



FREE Fall Catalog

Fully illustrated. Features quality apparel and footwear for men, women and children; camping, hunting, hiking and winter sports equipment. For 69 years L. L. Bean has offered practical and functional merchandise at reasonable prices. Our clothing and footwear is rugged enough to withstand active outdoor use, yet attractively styled and comfortable for casual wear. Many items are of our own manufacture. All are guaranteed to be 100% satisfactory.

SEND FREE CATALOG

Name_____
Address _____
City _____
State_____ Zip_____

L. L. Bean, Inc.
751 Casco St., Freeport, ME 04033



NATURAL HISTORY TOURS 1982

MASSACHUSETTS AUDUBON SOCIETY

WINTER
Jamaica
Arizona/California
Mexico (4 trips)
Hawaii
Cuba
Texas Coast
Senegal
Baja Ca.
Guatemala
Honduras

SPRING
Venezuela
Cuba: East
Texas
Ecuador
Galapagos
Smoky Mountains
Arizona
Spain/Portugal
Mongolia/Siberia

SUMMER
Churchill
Alaska
Western Parks & Mts.
Newfoundland
Kenya
Washington

FALL
California
New England
Bermuda
Mid-Atlantic Coast
Oaxaca
Kenya

For Details, Please Write:
Director of Tours
Natural History Services
Massachusetts Audubon Society
Lincoln, MA 01773

riously fallible instruments. (Anyone who thinks that claims for direct observation possess some special, irrefutable status should read Elizabeth Loftis's chilling book on eyewitness testimony.) Paleontologists, accepting the reality of orthogenesis, were primed to believe in *Gryphaea*'s overcoiling; telegony seemed reasonable until Weismann challenged it seventy years later. Secondly, facts achieve an almost immortal status once they pass from primary documentation into secondary sources, particularly textbooks. No medium is so conservative as the textbook; errors are copied from generation to generation and seem to gain support by sheer repetition. No one goes back to discover the fragility of original arguments.

I am not trying to convey the message that all knowledge is relative and that facts can never achieve universal approbation—quite the reverse. Rather, we have to distinguish which kinds of factual claims can achieve acceptance and which must remain in limbo. The most troublesome facts are single cases—the offspring of Lord Morton's mare, the overcoiling of one *Gryphaea*. We must, as William Bateson advised, "treasure our exceptions." But we must also be aware that single cases are fragile, and that sturdy facts are pervasive patterns in nature, not individual peculiarities. Most "classic stories" in science are wrong.

The need to distinguish sturdy fact (pervasive pattern) from shaky factual claim (single cases with dubious documentation) has never been more evident to me than in the current debate between evolutionists and those latterday antediluvians who call themselves, in the nonsense phrase of the decade, "scientific creationists." The fact of evolution is as sturdy as any claim in science (which does not mean that it is absolutely certain, because nothing is, aside from ignorant dogmatics). Its sturdiness resides in a pervasive pattern detected by several disciplines—for example, the age of the earth and life as affirmed by astronomy and geology, the pattern of imperfections in organisms that record a history of physical descent (the primary contribution of biology and the theme of so many of these columns).

Against this pattern, creationists employ the destructive, shotgun approach—presenting no testable alternative but firing a volley of rhetorical criticism in the form of unconnected, shaky factual claims—a potpourri (literally, a rotten pot, in this case) of nonsense that beguiles many people because it masquerades in the guise of fact and trades upon the false prestige of supposedly pure observation.

The nihilistic strategy goes something like this, and it forms effective, if ugly, rhetoric: this African carbon-14 date is way off, so radioactive decay can't affirm the earth's antiquity; these rocks from Colorado are younger than rocks piled on top of them, so geological succession does not record time. The individual claims are easy enough to refute with a bit of research. Creationists themselves have been forced to retreat from the more embarrassing items. Noted creationist Henry Morris, for example, has often cited the supposed footprints of dinosaurs and humans together in rocks of the Paluxy River of Texas. But creationist Leonard Brand attributes some of the "human" prints to erosion and others to a three-toed dinosaur. He also adds: "We do know that there was a fellow during the Depression who carved tracks."

Yet each time we explode one creationist "fact," two more are invented to take its place. Hercules finally killed the Lernaean Hydra, a beast with similar tendencies toward proliferation after partial destruction. We can deprive creationism of all intellectual respectability (though not, alas, of some popular appeal) by remembering that sturdy facts are built from widespread patterns and that coherence in structure is the sign of strong arguments and theories. Unconnected, individual items remain shaky until they form a pattern or attain a confidence in individual documentation that neither telegony nor overcoiling—not to mention any creationist claim—ever achieved.

If shaky factual claims were always easy to dislodge, this column could end on a purely optimistic note. But telegony lasted for seventy years, and the ghost of William Jennings Bryan again stalks our nation. If I end with measured optimism, however, I do so in urging that we focus upon the second phrase of what may be Darwin's most famous statement (from the *Descent of Man*): "False facts are highly injurious to the progress of science, for they often endure long; but false views, if supported by some evidence, do little harm, for every one takes delight in proving their falseness."

Stephen Jay Gould teaches biology, geology, and the history of science at Harvard University.

THIS BOOK FREE WITH YOUR SUBSCRIPTION



Yes, I want to stay up-to-date in all the sciences.

Enter my subscription to the monthly issues of SCIENTIFIC AMERICAN for the term I have checked. As soon as my payment is received, you will also send me The Physics of Everyday Phenomena (regular price $5.95) as my bonus.

MY GUARANTEE

I may cancel my subscription at any time and receive a refund on the unused balance. The bonus book is mine to keep.

SCIENTIFIC AMERICAN

PQ

- ☐ 1 year–$21
- ☐ 2 years–$38 (I save $4)
- ☐ 3 years–$52 (I save $11)

☐ I enclose $_____

☐ Bill me $_____

(Rates outside U.S. and Canada 1 year–$27 2 years–$48 3 years–$64)

NAME _____

ADDRESS _____

CITY STATE ZIP _____

☐ Start my subscription with the September single topic issue on genetic engineering.

NATURAL HISTORY

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD
First Class Permit No. 6005 New York, N.Y.

POSTAGE WILL BE PAID BY ADDRESSEE

SCIENTIFIC AMERICAN
P.O. Box 5918
New York, N.Y. 10164

The scientific-industrial revolution is on the threshold of developments from biology as momentous as any that have come from physics—all the way from the steam engine to the computer. For the new science of molecular biology has given rise to a new high technology...

GENETIC ENGINEERING

Under the title of Industrial Microbiology, the editors of SCIENTIFIC AMERICAN have devoted their entire September issue to this single topic.

In this issue, scientists and engineers actively engaged in the work present the full background necessary to common understanding of the new power to manipulate life processes that genetic engineering confers.

These authors review the origins of genetic engineering in the science of molecular biology and place in perspective the industrial application and prospective economic impact of this technology.

Hazards from this new technology must be reckoned with along with benefits. The engineering of life processes implies profound and troubling questions of ethics and value. For years to come, there will be no more authoritative or comprehensive picture of Industrial Microbiology between two covers than that presented in the September issue of SCIENTIFIC AMERICAN.

THE ARTICLES

- Industrial Microbiology
- Industrial Microorganisms
- The Genetic Programming of Industrial Microorganisms
- The Microbiological Production of Food and Drink
- The Microbiological Production of Pharmaceuticals
- The Microbiological Production of Industrial Chemicals
- Production Methods in Industrial Microbiology
- Microbiology in Agriculture

With this issue we continue a 32-year tradition of devoting each September issue to a single topic of current scientific and public interest. In the other monthly issues our readers enjoy a diversity of articles covering the full range of disciplines.

All the major advances in science of the past three decades have been reported in our pages by the scientists who did the work. More than 65 Nobel laureates have written for SCIENTIFIC AMERICAN, nearly all of them before receiving the prize.

The collaboration of our editors in the preparation of text and illustration makes the work of our authors accessible to a steadily growing worldwide readership.

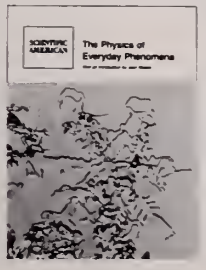
Why not join us at the frontiers of knowledge?

A one-year subscription is only $21. A two-year subscription, at $38, saves you $4. And a three-year subscription, at $52, saves $11.

Send no money. We'll bill you.

SCIENTIFIC AMERICAN

WITH YOUR SUBSCRIPTION...



THIS FREE BOOK

As soon as your subscription payment is received, we will also send you *The Physics of Everyday Phenomena* (regular price $5.95), as your bonus. This new anthology offers many surprises about things of nature so common as to be ignored in the confusion of daily life, such as fog, raindrops, snow crystals, thunder, ocean waves. Example: How would you describe the shape of a falling raindrop?

SCIENTIFIC AMERICAN 415 Madison Avenue, Dept. PQ, New York, N.Y. 10017

Yes, enter my subscription to the monthly issues of SCIENTIFIC AMERICAN for the term I have checked. As soon as my payment is received, you will also send me—absolutely free—the new anthology *The Physics of Everyday Phenomena* (regular price $5.95).

MY GUARANTEE
I may cancel my subscription to SCIENTIFIC AMERICAN at any time and receive a refund for the unused balance. The bonus book is mine to keep.

NAME

ADDRESS

CITY, STATE, ZIP PQ

☐ Start my subscription with September issue ☐ My payment is enclosed
☐ 1 year–$21 ☐ 2 years–$38 (save $4) ☐ 3 years–$52 (save $11) ☐ Bill me

(Subscription rates outside U.S. and Canada: 1 year–$27 2 years–$48 3 years–$65)

Rise of the Angiosperms

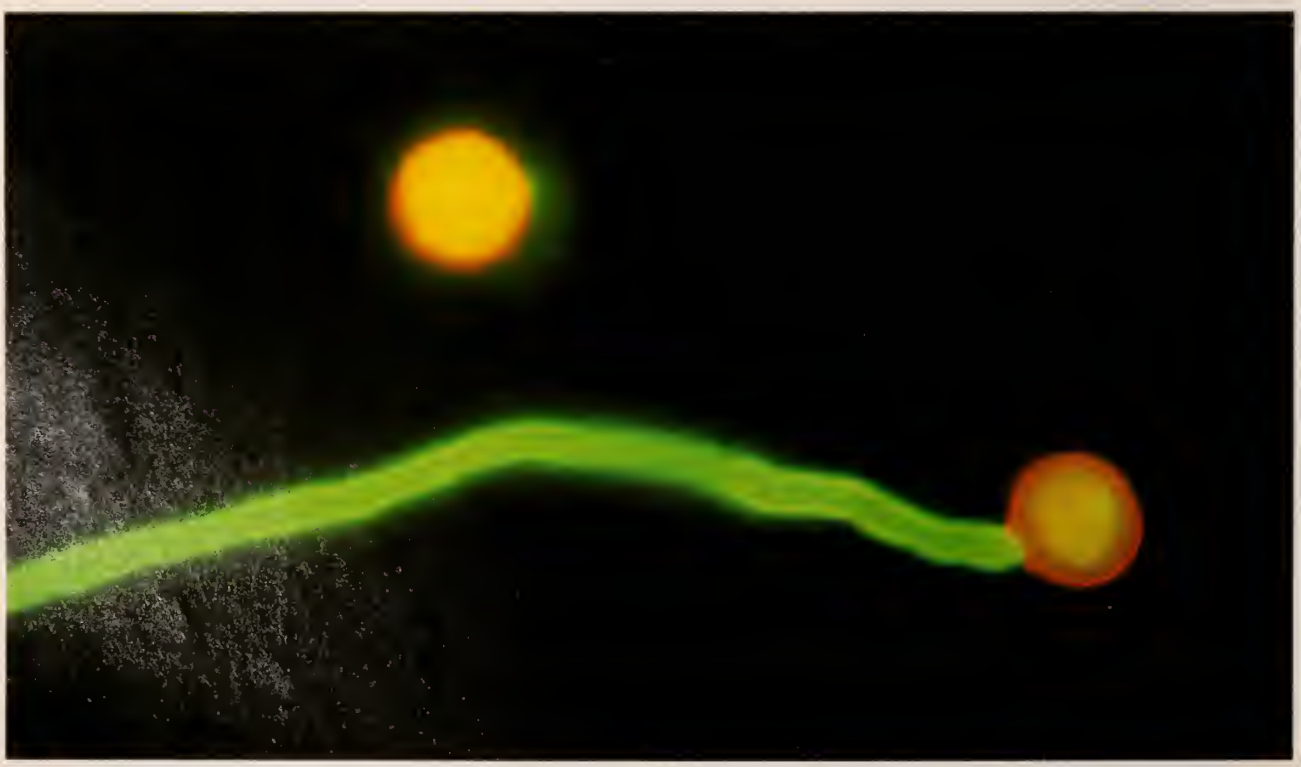
Among the pollen tubes of flowering plants, the race is to the swift and may help explain the angiosperms' success

by David L. Mulcahy

About 125 million years ago, the earth's terrestrial vegetation underwent a dramatic change. At that time, a newly evolved and highly competitive group of plants suddenly rose to dominance. These were the angiosperms, or flowering plants, and they relegated the gymnosperms (most familiar to us as conifers, but also including cycads and the ginkgo) and the ferns to a secondary position. The change was swift, at least in terms of geologic time and, to this day, irreversible. Angiosperms now occupy well over 90 percent of the earth's vegetated surface and, aside from some harvest of marine algae, constitute virtually 100 percent of our agricultural species.

Where did they come from, what were their ancestors, and most intriguing of all, why were the angiosperms able to displace the gymnosperms and the ferns from their position of dominance? We have answers to some of these questions, but to a considerable extent, the rise of the angiosperms remains for modern botanists, as it was for Darwin, an "abominable mystery." Today, in part because flowering plants represent the best hope for increasing agricultural yields and for utilizing the 36 percent of the land surface that is too dry, toxic, or saline to support present crop species, it is more necessary than ever to understand this fascinating group of plants.

On which points are present-day scientists closer to answers than were the Victorians? Thanks to Daniel Axelrod



Germinating pollen grain of tomato

David L. Mulcahy

To bring a touch of Oriental beauty to any room in your home





Custom-designed hardwood wall rack provided for display of the twelve Oriental tea cups. Tea cups shown smaller than actual size of 3¼ inches in height.

The Tea Cups of the Twelve Months of the Year

by Kinuko Yamabe

A collection of twelve Oriental tea cups . . .
each one symbolizing a different month of the year . .
and each portraying the particular flower
which represents that month in Oriental lore.

Crafted in fine porcelain, hand-decorated
in pure 24 karat gold and issued in limited edition.
Advance subscription deadline: September 30, 1981.

In the Orient, as far back as ancient times, flowers were a cherished part of the culture and the everyday life of the people. So universally loved and admired were the exotic flowers of the Orient that each month of the year was designated by a different flower. And that flower was said to symbolize all the virtues of that month.

Inspired by this charming custom, the gifted Japanese artist Kinuko Yamabe has created twelve original designs *exclusively* for a unique collection of tea cups honoring the flowers of the Oriental year.

Each of the twelve tea cups depicts a different flower. For January, the fragile Plum Blossom. For March, the Tree Peony. For April, the noble Cherry Blossom. For July, the Lotus. For October, the golden Chrysanthemum. And for December, the Poppy . . . Twelve exquisite flowers . . . twelve beautiful tea cups.

The artist has followed the ancient "Rimpa" tradition of Oriental art in creating these works—a style which intertwines the real and the imaginary. Thus, there is a hint of mystery about her art—suggesting that each flower has a deeper meaning than its beauty alone.

Each tea cup will be crafted in Japan by artisans whose skill in the porcelain medium is unexcelled. More than 18 different colors will be used throughout to match the variety of shades and tones the artist has used in her designs. Then, as an added touch, each cup will be individually *hand-decorated* with a border of pure 24 karat gold.

Today, Oriental porcelain has become one of the most desired of all forms of decorative art—and is used with any style of decor. This collection is especially desirable because it is exclusive and a limited edition. Yet it is reasonably priced—just $19.50 for each cup.

The advance ordering deadline is September 30th, and the rolls will be permanently closed in May 1982. After that time, this collection will never be available again. Please send the order form below to Franklin Porcelain, Franklin Center, Pa. 19091, by September 30th.

© 1981 FP

ADVANCE ORDER FORM

The Tea Cups of the Twelve Months of the Year

Valid only if postmarked by September 30, 1981.
Limit: One collection per person.

Franklin Porcelain
Franklin Center, Pennsylvania 19091

Enter my order for The Tea Cups of the Twelve Months of the Year by Kinuko Yamabe, a collection of 12 porcelain cups hand-decorated in 24 karat gold. They will be sent to me at the convenient rate of one per month.

I need send no payment now. Please bill me $19.50* for each porcelain tea cup in advance of its shipment. A custom-designed wall rack will be provided at no additional charge.

**Plus my state sales tax and $1 for shipping and handling*

Signature _____
ALL ORDERS ARE SUBJECT TO ACCEPTANCE

Mr.
Mrs.
Miss _____
PLEASE PRINT CLEARLY

Address _____

City _____

State, Zip _____

40



FROST-FIGHTER

Our 2-in-1 balaclava is styled like headgear worn by the British in the Crimean War. Today, it's the choice of skiers, backpackers and sailors. Undyed Ragg yarn is spun of 85% lanolin-rich wool for warmth and water repellency plus 15% nylon for strength. Folds up like a watch cap or turns down for greater coverage. Eye-shading visor. One size. **Color:** Salt & Pepper. **$7.50** ppd.

Order Today! Money Back Guarantee!

Enclosed is my check or money order for $ _____. (Add sales tax where applicable.)

Please RUSH my **#1994 Ragg Knit Balaclava.**

Name _____

Address _____

City _____

State _____ Zip _____

☐ **Send me your FREE color catalog of quality outdoor apparel and equipment.**

Eddie Bauer®

Dept. KNH, Fifth & Union, Seattle, WA 98124



Woodworkers' delight—A subscription to *Fine Woodworking* brings you an abundance of ideas and information on cabinetmaking, carving, marquetry and turning—the tools and techniques, materials and design. Each issue is carefully edited and beautifully printed. Join the 200,000 readers of this superb bimonthly magazine by sending your name and address, along with your payment, to The Taunton Press, 52 Church Hill Road, Box 355CM, Newtown, CT 06470. One year $14, two years $26, refundable. For gifts, please include both addresses. Visa or MasterCard accepted.

of the University of California at Los Angeles we may at least know something about the environment in which the angiosperms evolved and why their appearance was so sudden. His hypothesis is that the angiosperms arose in arid and montainous regions where the ponds and lakes that figure so prominently in the formation of fossils would certainly be rare. Without muddy lake bottoms, which are free of decay-causing oxygen and rich in fine-textured sediments that preserve the form and even the tissues of delicate structures, few fossils would be formed. There would be exceptions, of course, and there are some large lakes in mountainous regions. These lakes, however, would never be filled with the silts and clays that often protect fossil deposits in lowland lakes. Thus when mountainous regions are eroded away, the high-elevation lakes and fossils will go with them, and any traces of life they carried will be destroyed. If the Axelrod hypothesis is correct, the first steps in the evolution of the angiosperms may be lost forever.

The hypothesis also suggests something about the population structure of the ancestral angiosperms. Mountainous terrain is likely to be heterogeneous, and if the regions inhabited by the early flowering plants were arid as well, the plants growing there would probably have been limited to particularly favorable sites. Perhaps the first angiosperm populations occupied only the less arid swales and ravines and were separated from one another by hummocks and ridges. This population structure—a series of medium-sized groups separated by short distances—happens to be the one thought to best provide two requirements of rapid evolution: a good supply of genetic variation and a measure of isolation. The genetic variation contained in medium-sized groups may be adequate to produce individuals adapted to local conditions, but even if it is not, an occasional seed or pollen grain from a nearby group could replenish the stockpile. Moderate isolation would allow this occasional input of genetic material while at the same time preventing a flood of material that would disrupt adaptive gene combinations already present within the population.

The Axelrod hypothesis made a major contribution to the understanding of early angiosperm history, but unfortunately it tells little about how these newly evolved plants were able to outcompete and displace their gymnospermous antecedents. Here we must look to the angiosperms themselves. Their competitive superiority has been attributed to many different characteristics. For example, angiosperms generally produce broader leaves than gymnosperms; this enables the flowering plants to intercept more light for photosynthesis. Angiosperms also produce an amazing arsenal of foul-tasting or even toxic substances that presumably protect them from grazing animals and insects. Furthermore, angiosperms, unlike nearly all gymnosperms, possess vessel elements, specialized conducting cells that form highly efficient vascular systems.

Each of these characteristics has been implicated in the adaptive success of the angiosperms, but none is limited to the angiosperms. Ginkgo, a gymnosperm, produces broad leaves; the resins of the conifers clearly discourage even the most voracious herbivores; and *Gnetum,* another gymnosperm, produces vessel elements, as does bracken fern. Moreover, the more primitive angiosperms apparently lacked vessel elements. Perhaps all these adaptive features are more the products of angiosperm success than its cause. At best, they are probably only a part of the answer. For the rest, let us consider another characteristic of the angiosperms: their mode of pollen transport.

The primitive angiosperms were pollinated by insects, as are most of the present-day angiosperms. (There have been some reversions to wind pollination, but these occurred after the essential features of the angiosperms had evolved.) An intuitive presumption that insects are more reliable than the wind as a means of pollen transport is supported by some excellent studies by Robert W. Cruden of the University of Iowa. He has shown that with insect-pollinated species 6,000 pollen grains may be produced for each ovule, a large ratio but one that pales in comparison with the million-to-one ratio found in wind-pollinated species. This disparity suggests that even if insects consume a great quantity of pollen (up to 90 percent according to some estimates), they are still less profligate than the wind.

In addition, because insects fly more or less directly from flower to flower, they are far more likely than the wind to accomplish pollen transport between such moderately isolated subpopulations as the groups of early angiosperms proposed by Axelrod. The wind can carry pollen for many miles, occasionally covering the decks of ships far

Come share Costa Rica. From the lively town fiestas to the peaceful atmosphere.





Now 50% more for your dollar.

Peaceful Costa Rica is truly a country of contrasts. You can spend your morning walking a secluded beach and experience the thrill of a town fiesta in the afternoon.

If you choose excitement, Costa Ricans always have a reason to celebrate. A Saint's Day, a town fiesta, a bullfight Costa Rican style, or a carnival.

On the other hand, if you would rather escape from the hurrying world, there are plenty of places to get away. Volcanoes. Waterfalls. A jungle train. Peaceful beaches. And you'll experience a gentle hospitality that's hard to find anywhere else.

Three nights accommodations and a city tour start as low as $56 (IT1LR1PF38) per person double occupancy, plus air fare. And with Costa Rica's favorable exchange rate, now you get 50% more for your dollar.

For more information on Costa Rica, call your travel agent or write: COSTA RICA TOURIST BOARD, Box E13, 3709 N. W. 36th St., Miami, Florida 33142.

COSTA RICA

we have so much to share

at sea. As a general pattern, however, pollen grains become widely separated as the wind carries them along, their concentration falling by a factor of 30 million in just 800 feet. This means that beyond several feet from their source, wind-transported pollen grains will be relatively sparse.

If insects are the more dependable means of pollen transport, the issue then becomes one of enticing them to provide this valuable service. The early angiosperms apparently solved the problem by offering insect visitors a meal of pollen, a persuasive inducement since pollen is an extremely rich source of protein. The presentation of a pollen meal was not without problems, however. William Crepet of the University of Connecticut has pointed out that ovules, if they were to receive the gametes of the insect-transported pollen, had to be close to the insect visitors, and ovules are every bit as nutritious as pollen. They are not, however, nearly as abundant. Natural selection apparently favored plants in which ovules were afforded some protection from insect predation, ultimately resulting in the angiosperm ovary, a vessel that completely encloses the ovules. (The word *angiosperm* means "vessel seed"; *gymnosperm* means "naked seed.")

At this point it is possible to reconstruct an interesting (and universal) phenomenon. A problem, in this case the unreliability of the wind as a means of pollen transport, elicits a solution, for example, insect pollination. The solution produces its own set of problems, but unless the solution is no solution at all, these are less severe than the original problem. The secondary problems do, however, necessitate further adjustments in the system: in the evolving angiosperms, ovules had to be protected. Theoretically, this sequence of problems, solutions, and still more problems and solutions continues forever, but in reality, the adjustments probably soon become attenuated to the point of evolutionary insignificance. The important part of this phenomenon is that for many problems, there are several possible solutions. Some of these merely solve the problem at hand, but others may provide capabilities not directly selected for.

The Chinese incorporate an awareness of this duality into their language, using the single word *ji* to mean both "crisis" and "opportunity." In the case of the evolving angiosperms, the unexpected occurred in the third cycle of crisis and opportunity. Enclosing the ovules in protective structures did protect them from insect predation, but it also isolated them from the pollen grains. The solution to this third-level problem lay in the evolution of pollen tubes that could grow from the pollen grains through the intervening protective structures and into the ovules. This solution may have presented the angiosperms with a great opportunity. Consider the fate of the pollen grains of gymnosperms. Carried by the wind, most are lost, regardless of their quality or genetic content. For those that do reach an ovule, the worst is over; developing eggs lie just a few cells away. Even fairly weak genetic types are probably able to complete this final part of the journey. The challenge of this last stage is further reduced by the small number of pollen grains likely to reach any particular ovule, so competition among pollen tubes should be modest.

In contrast, all available evidence suggests that although many of the pollen grains of an insect-pollinated angiosperm are sacrificed to insect nourishment, enormous populations still reach their target, the angiosperm stigma. There they germinate and rapidly produce pollen tubes, which must penetrate the great length of tissue separating them from the ovules. In five to ten hours, for example, the pollen grain of *Petunia* produces a pollen tube whose length is about 900 times the diameter of the original pollen grain. This rate is comparable to a basketball-sized sphere producing a tube about one-fifth of a mile long. Since only a well-balanced and vigorous physiology can sustain such growth, this marathon of pollen-tube development presents a challenge to the metabolic system of the pollen. Furthermore, with insect pollination the number of pollen grains reaching the stigma probably greatly exceeds the number of ovules available for fertilization. This creates an intense competition among the pollen tubes, and only the fastest growing, only the most vigorous will pass their gametes on to the next generation. Therein lies the surprising opportunity for the angiosperms.

Pollen competition apparently provides a mechanism whereby poor genetic types are eliminated and vigorous types preserved. This idea is not new but neither is it universally accepted. Some evolutionists view the extraordinarily intense competition that occurs among pollen tubes as a real danger point in the life cycle of a flowering plant. In 1932, for example, the geneticist J.B.S. Haldane suggested that a gene that greatly accelerates rates of pollen-tube growth will spread in a population even if it has mildly deleterious effects in other parts of the life cycle. "A higher plant," in Haldane's words, "is clearly at the mercy of its pollen grains." Experimental evidence, however, supports a much more sanguine view. Several investigators, beginning with the Russian geneticist D.V. Ter-Avanesian in 1949, have found that in cotton, wheat, corn, tomatoes, petunias, and carnations, gametes from rapidly growing pollen tubes give rise to vigorous plants. Thus, with apologies to Robert Frost, one might say that "good pollen tubes make good plants." It therefore becomes significant that only the angiosperms have a highly effective method of selecting for rapidly growing pollen tubes.

One of the most powerful aspects of pollen tube selection is that vast numbers of individuals are involved, but the system has a qualitative advantage as well. Remember that within plant embryos, seedlings, and mature individuals, every cell (except the gametes) carries two sets of genes, one inherited from each parent. This diploid state has some advantages, chief among them being the ability to store genetic variation, but it has disadvantages as well. Recessive genes, for example, are expressed only when they are carried in all (here both) sets of genes within a cell. Suppose that, by chance, a rare but highly beneficial recessive gene appears within a population. Because it is so rare, there is little chance that it will occur within both gene sets of a cell. The gene, with its beneficial characteristics, will remain unexpressed. Within pollen, however, each cell is haploid and thus contains only one set of genes. Consequently, any gene beneficial to the pollen, even a very rare one, will be expressed within the pollen grain and favored by natural selection. This beneficial gene will increase within the population and eventually reach levels at which both gene sets in some seedlings will carry it. In these respects, pollen grains are similar to bacteria, organisms that exhibit a truly astonishing ability to respond to selection. We have only to consider the ease with which bacteria have developed resistance to many antibiotics in order to realize how adaptable they are. Microorganisms can produce a new generation as quickly as larger organisms can produce a new cell. Thus they can invade any new

habitat or respond to changing conditions with billions of individuals. Also, because microorganisms are haploid, mutations are expressed, and genetic adaptations tested, immediately.

There is another aspect to the potential benefit of a pollen selection system. George Williams of the State University of New York at Stony Brook and V.C. Wynne-Edwards of the University of Sussex have asked what are the contributions that sexual reproduction makes to the process of adaptation. Granting that it provides new and possibly adaptive genetic combinations, they point out that sexual reproduction also has a negative effect. The sexual process takes two perfectly good genetic types (good enough, that is, to survive to, and perhaps through, the rigors of parenthood) and scrambles them together, risking the loss of the good qualities of both parents. Williams and Wynne-Edwards suggest that unless populations are huge, on the order of tens of millions of individuals, sexual reproduction may cost more than it gains. Here is where pollen tube competition may become important.

In both angiosperms and gymnosperms, for each individual that reaches maturity, large numbers of seedlings are started. However intense this selection among seedlings may be, the angiosperms, as we have seen, possess yet another level of selection. Pollen tube competition may mean that the angiosperms, when compared with the gymnosperms, are relatively free to recombine genetic types, and that the selected products of this recombination are quite certain to possess a reasonably well-balanced, vigorous gene set. The gymnosperms, lacking the opportunity for intensifying pollen tube selection, would be forced to adopt a relatively conservative genetic system, one that preserves adaptive genetic types rather than producing vast numbers of new adaptations.

Intense pollen tube competition, an accidental consequence of the shift from wind to insect pollination, may thus have granted the angiosperms carte blanche for genetic experimentation. This evolutionary plasticity may have led early and often to adaptive features, rare or absent within the gymnosperms, that enabled the flowering plants to reach their present position of dominance in the world's flora.

David L. Mulcahy is a professor in the Botany Department of the University of Massachusetts at Amherst.

You never forget your first Girl.





Monkey Moves

Among western red colobus monkeys, females have the freedom to transfer from troop to troop. The males generally don't

by E. D. Starin

I had spent weeks trying to observe the shy, predominantly arboreal western red colobus monkey in The Gambia's Abuko Nature Reserve, and still could not understand what type of social organization they possessed. For much of the time I saw only a foot here, a tail there, and then a mass of black-and-reddish bodies fleeing through the forest canopy and leaping out of sight. After weeks of not always being able to differentiate females from males, of not knowing whether I was watching one troop or two, I was about to give up trying to concentrate on social behavior when one day the colobus stopped running and hiding and allowed me to follow them throughout their home range.

Red colobus monkeys are spread throughout equatorial Africa, in a variety of habitats from The Gambia to Zanzibar. In The Gambia, they inhabit riverine forest, mangrove swamp, various types of savanna, village perimeters, and infrequently, residential gardens. For the past forty-two months, I have been studying the socioecology of the western red colobus monkey (*Colobus badius temminckii*) in the Abuko Nature Reserve. The reserve, located about twelve miles from the capital, Banjul, comprises some 263 acres of riverine forest; shady, dense raffia palm swamp; sunny, swampy clearings; and various types of savanna. Scattered throughout the reserve's swamps are pools inhabited by both Nile and dwarf crocodiles.

The colobus share the reserve with two other monkey species: the red patas and the green vervet. Although patas and vervets eat some of the same foods as the colobus, there is probably little competition. The patas monkeys live in harems and spend most of their time on the ground in the savanna zones and croplands that surround the reserve. Foraging through leaf litter, patas appear to consume insects and small reptiles, such as skinks—food sources the thumbless colobus would find difficult to harvest. The vervets, on the other hand, are everywhere, utilizing all levels in all habitat zones—from digging holes in the savanna to sleeping, feeding, and resting high in the riverine canopy. Young vervets have even been seen playing and possibly feeding in puddles. Although they eat some of the same fruits, flowers, stems, and young leaves as the colobus, vervets also feed on items not eaten by the colobus: insects, mushrooms, tender grass shoots, palm-nut kernels, tubers, and red ant nests. Although classified as folivores, the Abuko colobus feed on large amounts of fruits, flowers, and seeds. They even consume the odd gall and appear to relish the soil from abandoned termite trails.

The vervets and patas have an essentially neutral relationship with the colobus. In fact, the patas and colobus rarely meet. In forty-two months, I saw patas in the main study troop's home range on only fourteen occasions. Vervets and colobus, however, do occasionally interact. (When a colobus and a vervet of the same size meet on a path, the colobus usually takes precedence. Often, if a small colobus is threatened by a larger vervet, the colobus will either ignore the vervet or it will squeal until a gang of its older associates arrives and chases the vervet off.) While one-and-a-half to three-year-old female colobus frequently seek out nearby vervets for grooming and resting sessions and have even attempted to kidnap newborn vervets from their mothers, young male colobus tend to ignore the vervets. One young male colobus, however, spent more than a year as a member of a vervet troop while he shadowed colobus troops.

There are probably few carnivores in the reserve capable of taking a colobus. The Nile crocodile and the African python do prey on them, however. And while I have never seen colobus being attacked by birds of prey, they give alarm calls at most large birds; one adult female and her two-year-old son even gave alarm calls at a falling three-foot-long leaf, and an adult male gave an alarm call at a low-flying helicopter.

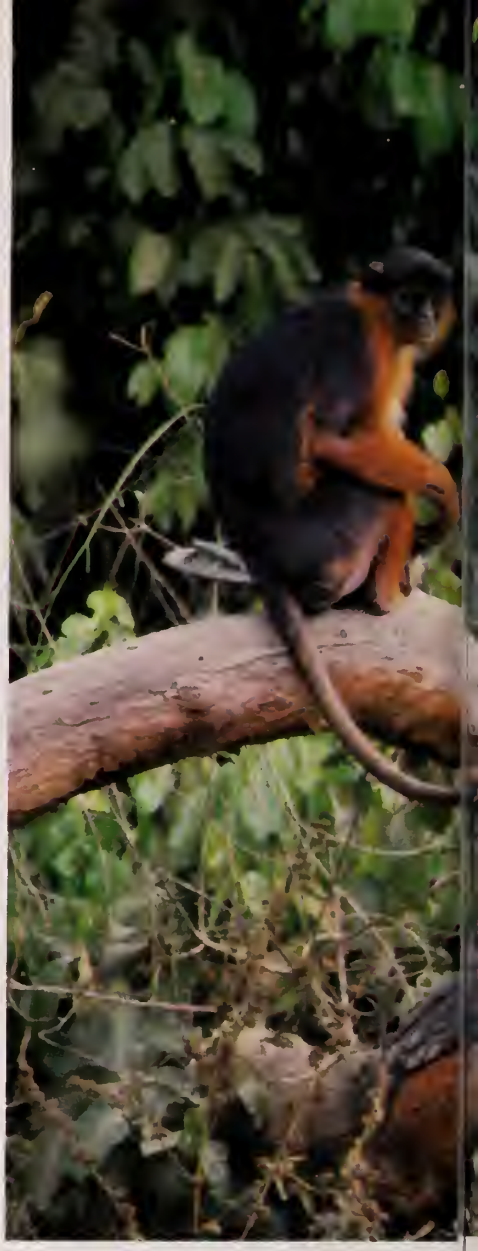
There is a tremendous amount of individual variation in colobus facial features, hair color, postures, and vocalizations—traits that the colobus probably use to recognize each other. And what I found most intriguing were the individual behavioral differences, which in many cases do not appear to be related to gender. After I gradually learned to recognize individuals, it became clear to me that the Abuko colobus do not live in compact troops. Rather, they exhibit a form of "fusion-fission" social organization, that is, like

Aggression is infrequent within a troop of western red colobus. Moments before this photograph was taken, this adult female expressed a threat, but quickly changed to the expression of appeasement seen on her face here.

E. D. Starin

E D Stann





A female pauses with her twenty-day-old infant, above, which will be weaned when it is roughly nine months old. The group of colobus resting calmly on the branch of a tree, right, includes an adult male (center) and an adult female (right). The female's two-year-old daughter (left) will transfer out of her natal troop just before or during her first estrus, which will occur when she is three.

chimpanzees, South American spider monkeys, and hamadryas baboons, colobus troop members form subgroups that separate and coalesce. Moreover, it soon became apparent that all females and most males leave their natal troop, that the two sexes display very different behaviors when transferring between troops, and that males attempting to enter a new troop are sometimes killed.

While female transfer may be unusual for nonhuman primates—only gorilla and chimpanzee females are known to regularly transfer between social units—it may be a general red colobus trait. Researchers studying red colobus in the Kibale rain forest in Uganda and in the gallery forest along the lower Tana River in Kenya also found that females are the most mobile individuals. It is not yet clear, however, whether the continual separating and coalescing of individuals and the killing of intruder males are species-specific traits or adaptations to the specific ecological, demographic, and social conditions of Abuko.

Most red colobus in the Abuko reserve live in mixed social units, called troops, of about twenty-three individuals. At present, my main study troop has nine adult females, two adult males, seven subadults and juveniles, and five newborn infants. The surrounding troops,whose home ranges overlap extensively with that of the main study troop, show similar compositions.

Each troop consists of individuals that associate together frequently and peacefully and share a common home range. Older individuals take precedence over younger ones, and mothers will defend their young, but aggressive interactions between resident troop members are infrequent. What intratroop conflict occurs generally takes the form of facial and vocal threats and rarely entails fighting. Frequently, a threatening facial expression is quickly transformed into an appeasement expression and a grooming bout ensues. Because of the rarity of agonistic interactions, the frequency of friendly behaviors, and a weakly defined adult-dominance hierarchy in which the resident males and females actively cooperate to repel some intruder males, it appears that dominance–subordinance relationships are not too important in maintaining harmony within the troop.

Troop members frequently separate and reunite. Sometimes up to three separate groups are formed, and these subgroups can remain apart for days at a time. The colobus pattern differs from the observed fusion-fission of chimpanzees, hamadryas baboons, and spider monkeys in that colobus spend more time together as a troop, and resident adult males seldom wander off alone or in a group. Resident adult males in their prime are normally with at least one female. Resident colobus females, however, have been observed to wander off alone. And old adults of both sexes wander off alone before they die. Because of this fusion-fission, mothers can be observed in different subgroups from their unweaned offspring for days at a time. (After they are nine months old,



colobus offspring can get along without milk. One female was orphaned when she was nine months old, and while she did not need her mother's milk, she probably did need a protector. Her older sister adopted her and was extremely possessive and protective toward her, much more so than any mother would be. This restrictive "sistering" probably reduced the chances of falls, kidnapping, and predation, but it also probably contributed to the orphan's obviously slow social development.)

The continual separating and reuniting of troop members takes place throughout the year, probably for a variety of reasons. The fluidity of the troop allows each member to move freely and thus avoid aggressive interactions. During the mating season there is much helter-skelter movement; boisterous, highly visible nondirectional displays by estrous females are frequent; and intermittent, aggressive intertroop encounters and male–male harassment take place. During this period it is not uncommon for old females and pregnant and lactating females with their dependent offspring to absent themselves from the males and estrous females. Such females and their young would have little to gain by getting involved in intertroop encounters at this time.

Fusion-fission is more apparent during the mating season, but because it also occurs during the rest of the year, it can be viewed as a response to the density and dispersion of resources. When a major food source is heavily clumped and can support many feeders, the entire troop will frequently feed together. When the major food source is widely dispersed or when there are many major food sources available at the same time, the feeders tend to break up into various subgroups throughout the range, thereby minimizing competition and maximizing the amount of range monitored. Because they are spread over a larger space, the colobus see more of the range and possibly learn about the availability of food sooner.

While the size and composition of each subgroup is not stable and endless combinations of individuals occur, there are some common patterns. Members of the same subgroup tend to be close associates. Some females have very close relationships with each other. They groom frequently, huddle together, and their offspring are playmates. They will defend each other

E. D. Stann



E. D. Stann



An adult female red colobus grooms an adult male green vervet, above. Such grooming bouts are a frequent sight in The Gambia's Abuko Nature Reserve, where the vervets are ubiquitous. Red colobus males may even join a group of vervets while shadowing a colobus troop that they want to transfer into. Other types of interactions between the two species, such as the scene at right, are rare.

against females from outside their subgroup and will even defend each other's young. Other females, however, rarely interact. When subgroups of female associates form, they tend to use the same area of the range continually, and these favorite areas tend to be in overlapping troop zones. Close associations and the use of favorite areas may occur because all females transfer out of their natal troop. When females that are age-mates and thus not sisters (or at least do not have the same mother, although they may have the same father) transfer into the same troop, they tend to spend the majority of their time together. When these females wander off as part of a subgroup, they tend to go to areas where their present troop range overlaps with their natal troop's range. Why they return to these areas is not clear. They do not interact peacefully with any of their previous troop mates. In fact, they either ignore, threaten, or flee from individuals they once associated with peacefully. They may be monitoring the resource situation and social setting for a possible return. It is not yet clear whether females ever return to their natal troop for an extended period. Certainly some females transfer more than once. One subadult female joined the study troop during estrus, transferred to a neighboring troop for the birth of her son, and then returned to the study troop with her month-old offspring. Another adult female accompanied her prepubescent, subadult daughter to a neighboring troop, stayed with her for a week, and then returned to the study troop.

Females transfer voluntarily and successfully. They do not spend time as solitaries shadowing other colobus troops; rather, they tend to transfer during intertroop encounters. A few months before transferring, a female's behavior changes. She begins to seek out vervets for resting and grooming sessions, and eventually she will head off in a direction opposite from the troop. An adult male usually runs after her. The male will not attempt to herd her, but will make a number of friendly gestures, such as mounting and grooming. So far, however, I have not seen a male successfully entice any young female to stay in her natal troop. All of the females known to have been born into the main study troop have left either before or during their first adolescent sexual swelling, which occurs during their third year.

When a female transfers, she is accepted by the males and the subadult and juvenile females in her new troop. She will usually be chased and receive threats from some of the resident adult females. These differing reactions are to be expected since the female will be a potential mate for the males and a potential competitor for resources with the other females. Because juvenile and subadult females will soon be leaving the troop, they will gain if the new female stays in their natal troop, instead of transferring again, possibly to become a potential competitor in their new troop. Although all females leave their natal troop, they are replaced by



young females from other troops, and so this practice has little effect on troop size and composition.

Young males also leave their natal troop, but the process is not voluntary and it can be unsuccessful. As young males matured in the study troop, they were basically ignored by the resident adult males but harassed by a three-year-old native male. After much harassment by this male, all three juvenile males left the study troop and began to travel on their own, generally avoiding their natal troop. One young male that returned for a day was continually threatened by the three-year-old male and virtually ignored by most of the other troop members, except for his mother, who spent the entire day and probably most of her energy trying to defend him from the harassment of the three-year-old native. This is in direct contrast to a young female that returned for a day. She was enthusiastically greeted, groomed, and invited to play.

Two unsuccessful male transfers took place during the study. In one case, an adult male joined the troop for one month. During this time he avoided the resident males, threatened the juveniles, and frequently ran into the center of a resting group, mounted a female, then ran off. After one month of avoidance, bullying, and "sneaking" copulations, he was attacked and killed by two of the resident females and one of the resident males. In the other case, a large subadult male shadowed the study troop for a few days and then walked into the center of the troop where he was groomed by the juvenile females. After an hour of what appeared to be acceptance, he was viciously attacked by at least seven of the resident females and one of the resident males. When my proximity to the incident brought the attack to an end, the male had severe wounds on his body and was bleeding profusely. Barely able to move away, he had lost one eye and probably died shortly after. In both of these attacks, the victim was pinned to the ground and the attackers bit furiously. In another case, I heard a loud uproar from a neighboring troop, and when I reached its territory, found a dead, twenty-three-month-old male that had been expelled from the local troop. The severe bites on his body looked as though they were inflicted by colobus canines. While it is not uncommon for a subgroup of lone females to

World Wildlife Fund, M. Bijleveld



E. D. Stann

Pools and swamps in the Abuko reserve, left, are inhabited by Nile crocodiles, predators of western red colobus. The young pregnant colobus, right, is engaging in a grooming bout with a 3½-year-old male.

threaten and give chase to strange males, strange males have not been observed threatening and chasing resident females. In fact, one strange adult male, while being chased off by the local troop, gave frantic appeasement gestures to a resident adult female that ignored him.

I did witness one successful male transfer. A young subadult male spent more than a year as a member of a vervet troop, shadowing both the study troop and a neighboring troop. After one of the two resident males in the neighboring troop disappeared, this young male successfully joined the troop and has now been resident for one year. There is also a very old adult male now living on the periphery of the local troop's range. While he occasionally meets up with an exiled thirty-two-month-old male from the local troop, he spends most of his time alone, moving slowly on the forest floor, avoiding all contact with mixed groups.

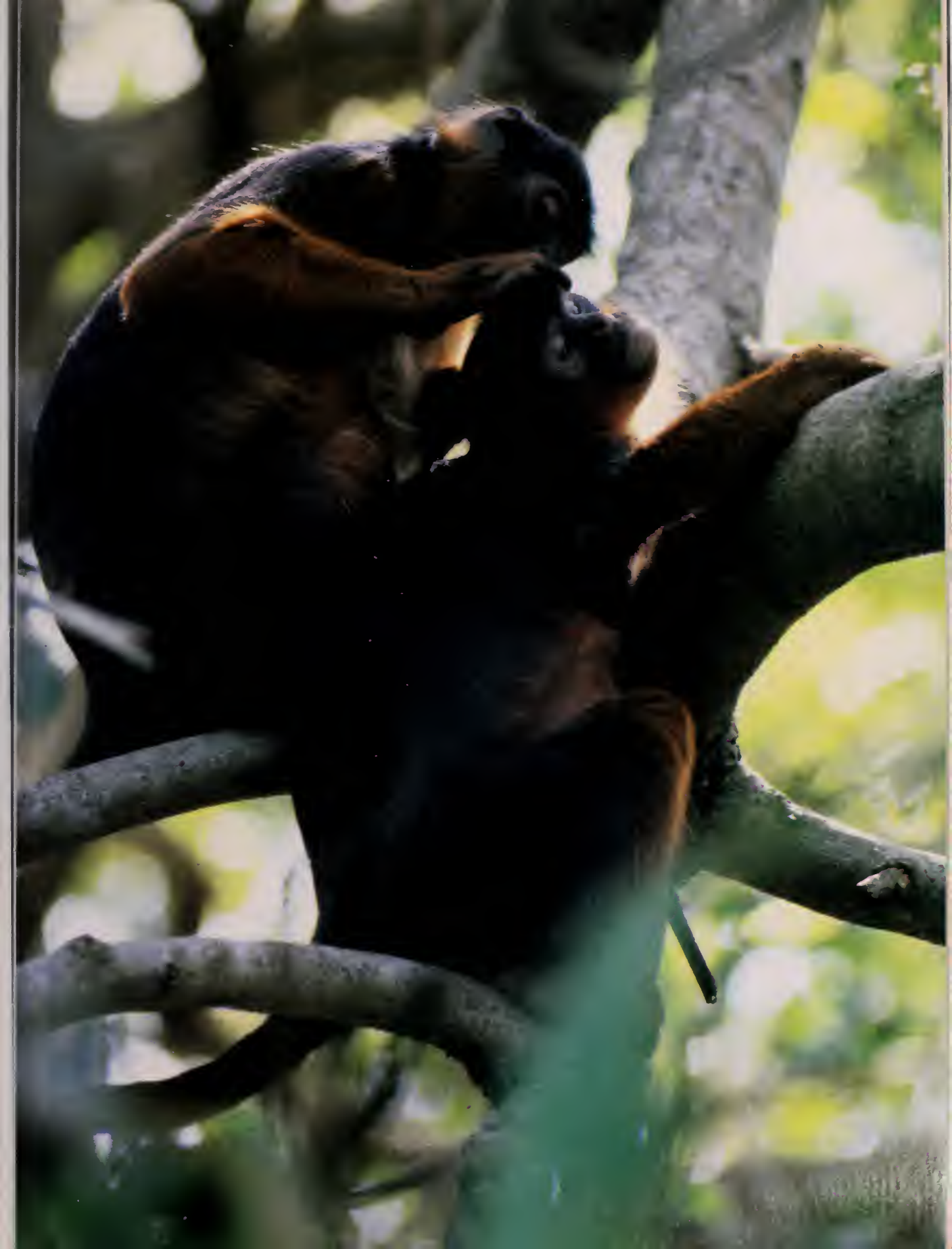
The methods and results of transferring show clear sexual differences. This suggests that the troop has very different meanings for females and males. A colobus female probably views a troop as an open unit that she can easily investigate and, if she chooses, can join. If she decides that another troop would be better, she switches. The decision as to what troop she will join appears to be entirely up to her. Her allegiance to her present troop is intense, but she is liable to make a quick switch. This may be why males rarely display aggressive behaviors toward females, for there is always the possibility that if life gets too rough, a female will simply pick up and leave. Certainly, males do not normally dominate females, and it is often apparent that males go out of their way to engage females in friendly behaviors.

A nonresident colobus male probably sees a troop as a fairly closed unit, which he can only investigate from afar and cannot easily join. The decision as to whether he will join a troop is not up to him alone. Rather, it is a decision probably made by the resident troop members. If he is able to stay in his natal troop or make a successful transfer, his allegiance, like that of the females, is also intense. Once in a troop, he will use all his persuasive powers to try to get as many females as possible to remain with him.

In the literature, there are frequent statements that transfers between troops occur in order to eliminate the possible deleterious effects of inbreeding. If this were the only reason for transferring, then only one of the sexes would have to relocate. Both sexes leave the natal troop, however, so it must occur for another reason or, more likely, a number of reasons.

Clive Marsh, who studied the Tana River red colobus in Kenya, has suggested that the function of female transference may be related to mate choice and the avoidance of infanticide. This suggestion appears to hold true for the Abuko red colobus population. Many of the more interesting behaviors—the killing of intruder males, particularly by adult females; the ease with which females can investigate troops; the difficulty males have in gaining access to troops; the chasing off of strange males by females; and the rarity of aggression displayed by resident adult males toward females and their offspring—may also be related to choosing mates that are not potentially infanticidal. It may not be mere coincidence that both observed attacks were led by females, that no mother with dependent offspring was seen anywhere near an intruder male, and that all partly weaned young ran off and quietly hid for the duration of the attacks. Females may well be able to judge which males will be promising mates and which are potentially infanticidal, and act accordingly.

Although we now know that red colobus display a form of fusion-fission organization, that females voluntarily leave their natal troop, that males are usually expelled, that females transfer easily and successfully between troops, that males encounter more difficulties in joining a new troop, and that intruder males are sometimes killed, the colobus puzzle is still partly scrambled. Do grandmothers ever meet their grandchildren? Does a younger sister join the same troop as her older sisters? Does the mother's behavior determine whether her son will remain in the troop or leave? Do expelled juvenile males return to their natal troops when they reach adulthood? Is female friendship based solely on a common natal troop experience? How closely related are female associates? Why are some intruder males killed and others accepted? What is a female investigating when she enters a new troop? Why do some females transfer over and over again and others perhaps only once? In light of the current interest in reproductive strategies, male and female behaviors, and kinship theories, the red colobus are very intriguing and appropriate animals to study. □



Saturn's Surprises

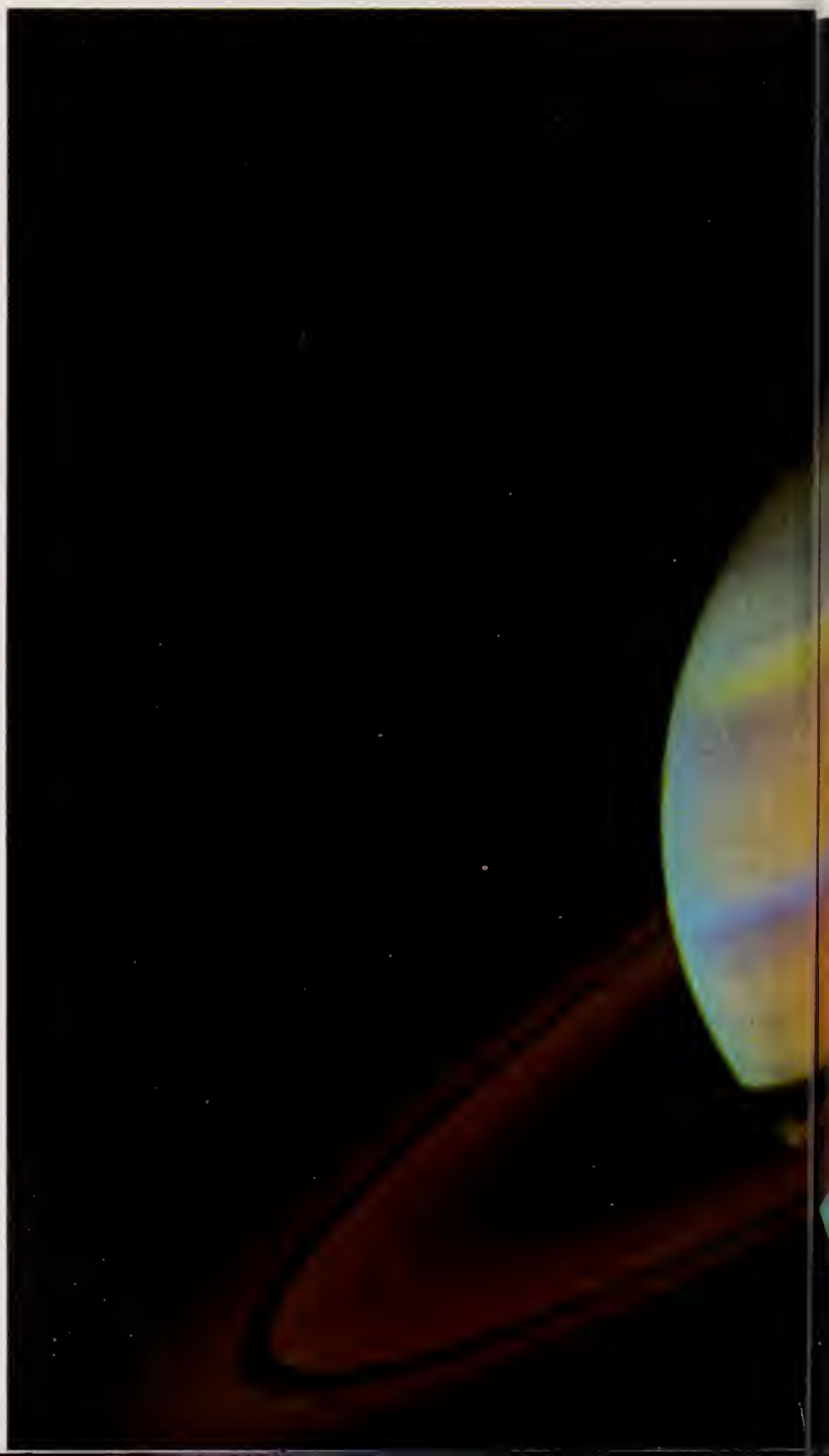
Unpredictability was the only predictable aspect of the data sent back by the Voyager 1 *spacecraft from this giant planet*

by Andrew P. Ingersoll

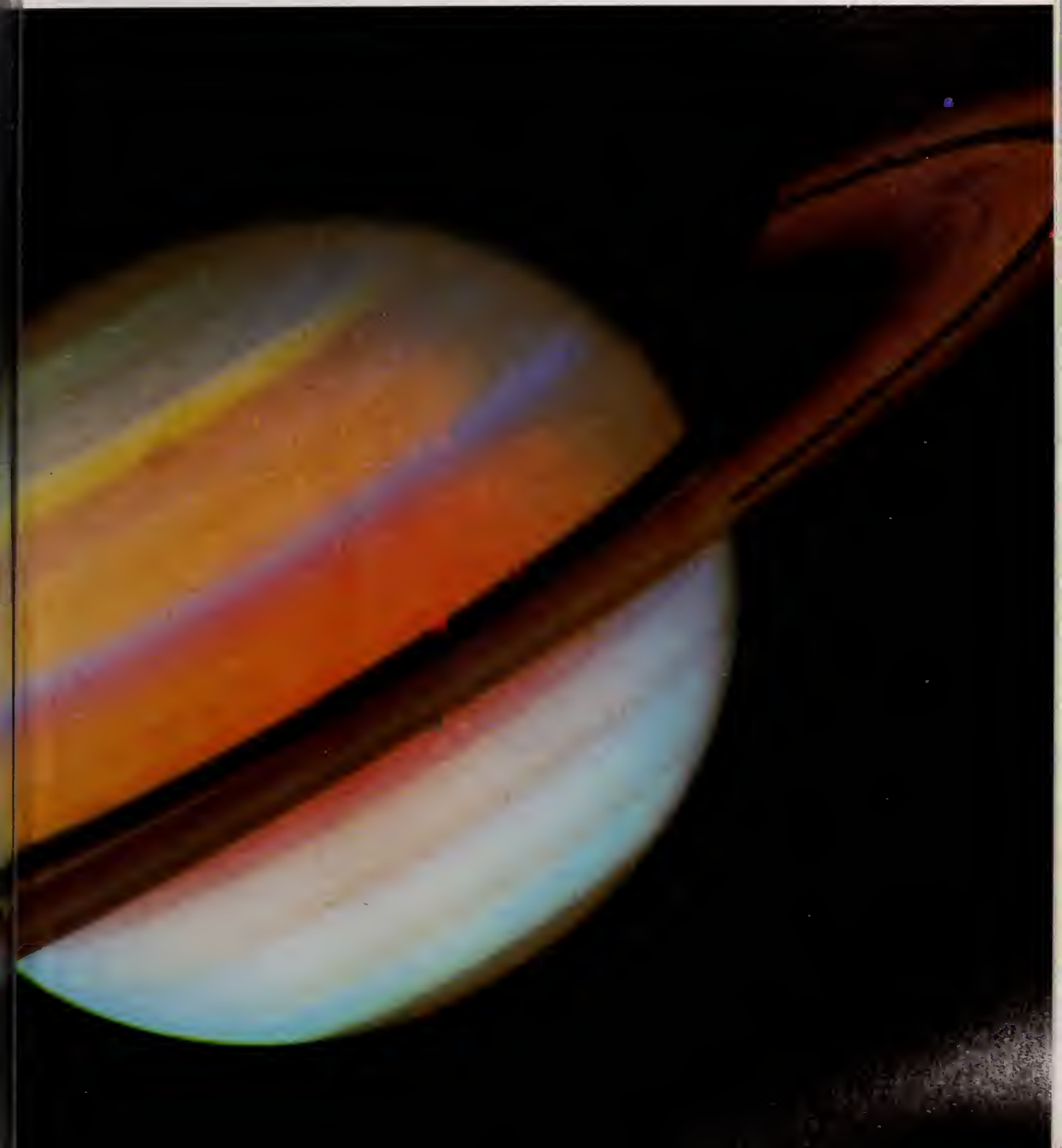
Scientists awaiting the *Voyager 1* encounter with Saturn in November 1980 were concerned that the second giant planet might not be as interesting as the first (see "By Jove," *Natural History*, May 1980, describing *Voyager*'s encounter with Jupiter). Saturn's famous rings might be featureless. The surfaces of its satellites might reveal no record of geologic activity. A uniform haze might hide the colorful swirling clouds on the planet. And the atmosphere of Titan, Saturn's largest moon, might prove to be disappointingly thin. But Saturn was not a disappointment, its richness proving once again that new worlds are worth exploring.

As planets go, Saturn and Jupiter are in a class by themselves. They are not massive enough to be stars, although they are made of the same elemental mixture that makes up the stars and the sun. They shine by reflected light, as the other planets do, yet they also emit appreciable amounts of stored internal energy. Like the sun, they are gaseous objects without solid surfaces on which to land a spacecraft. Saturn is less massive than Jupiter and colder. Both have rings and more than a dozen satellites. Together they account for more than 90 percent of the solar system's mass outside the sun. And the study of these great planets not only teaches us about our own world and its history but also allows us to test our model of solar system formation.

Perhaps the most interesting and special feature of Saturn is its system of rings. These are not solid sheets but billions of particles, small satellites, in fact, orbiting around the planet. Long ago, collisions between the particles eliminated most out-of-plane motion as well as motion toward and away from Saturn. Thus, from afar the rings appear perfectly flat and circular. Earth-based observations suggest that the particles range from one to ten feet in diameter and have water-ice surfaces. Several rings are visible from the earth. Starting farthest from Saturn, these are the A ring, followed by a narrow, semitransparent "gap" called the Cas-



Photographs from NASA



sini Division, then the almost opaque B ring, and finally the semitransparent C ring closest to Saturn. The Cassini Division is named after the seventeenth-century astronomer who discovered it. This gap is thought to represent the perturbing effects of Mimas, Saturn's innermost large satellite, which completes one orbit as the particles in the gap complete two orbits. One or two other gaps had been seen from the earth, but little else about Saturn's ring structure had been seen or could be anticipated.

Hence the structure viewed by *Voyager* came as a welcome surprise, providing information on which to test theories of ring origin and evolution. Instead of two gaps there were hundreds. Rings (or ringlets) appeared within the rings, almost without limit as the resolution of the *Voyager* images improved. The Cassini Division, itself a huge structure as wide as the North American continent, was found to have gaps and rings down to ten miles wide. Only a narrow zone where the orbital period of a hypothetical particle is exactly one-half that of Mimas was found to be truly empty.

A simple fractional relationship between periods, such as exists between the Cassini Division and Mimas, is called a resonance. According to theory, whenever ring particles are resonating with a nearby satellite they begin to swing back and forth, nearer and farther from Saturn. The effect is like pushing a swing. The push can come every time the swing returns to its highest point or every other time or with more complicated regularity. But if the push is large enough, the swinging will increase. Mimas exerts a gravitational pull, not a push, on the particles in Saturn's ring structure, but the net result is the same. The swinging of ring particles in their orbits causes the particles to collide. The places where the swinging amplitude is largest, where there are resonances, are cleaned out by collisions. The trouble is that the known satellites have only a few strong resonances, not enough to explain the hundreds of observed gaps.

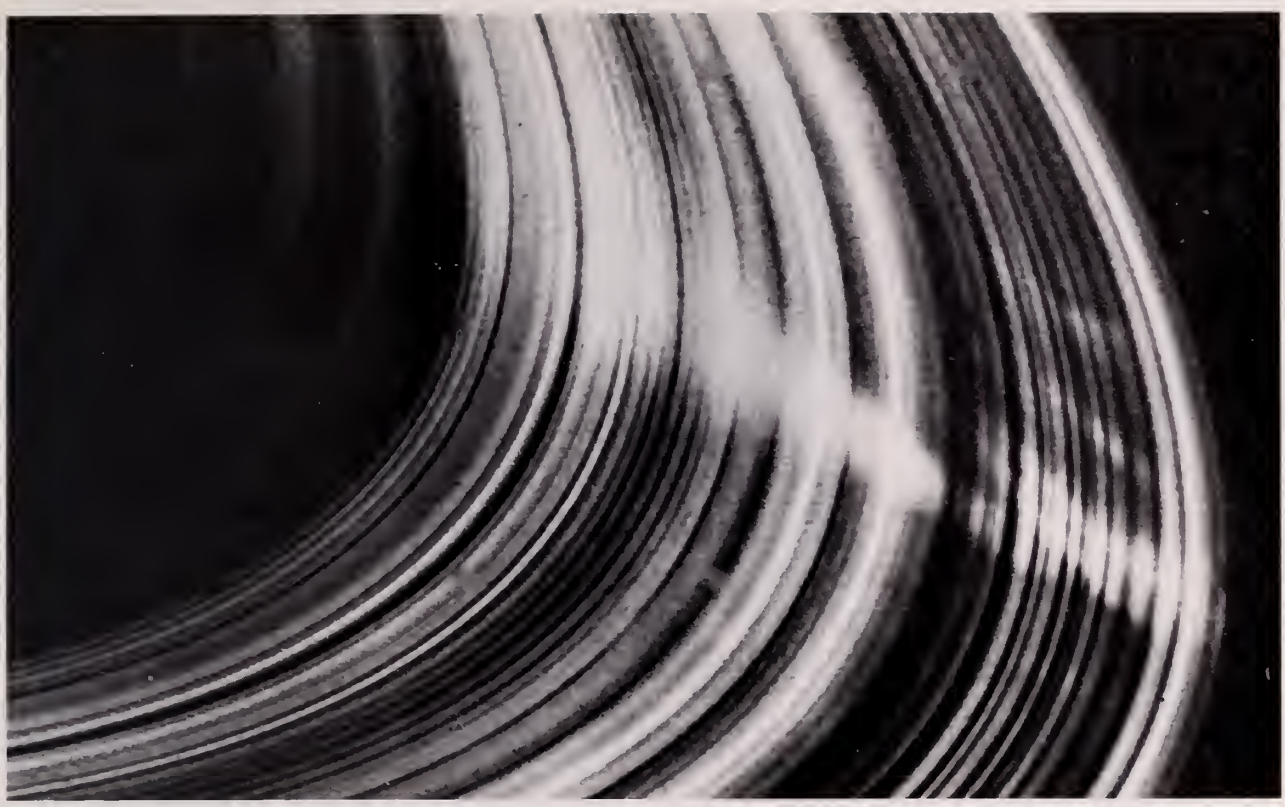
The current view is that there are hundreds of unseen "pushers" hidden in the rings. These might be objects one to ten miles in diameter, orbiting alongside the one- to ten-foot-sized objects known to be present. In *Voyager* images such tiny satellites would be barely detectable against the blackness of space. They can apparently escape detection by hiding among the smaller bodies. Nevertheless, their existence is reasonably well established, forcing us to consider a much wider size range for the ring particles.

The existence of ring particles in the one- to ten-foot range can be inferred from the way the rings scatter radio waves at these wavelengths. The presence of much smaller particles, of the order one ten-thousandth of an inch, was revealed by *Voyager* observations of the way the rings scatter sunlight. Clearly, different processes control the abundance of objects in these very different size ranges. One theory that now looks attractive is that Saturn's rings are the remains of a satellite or group of satellites that broke up, rather than a satellite that never formed. Gentle collisions within a cloud of particles tend to produce a more uniform-sized distribution, but violent collisions of large objects tend to produce both large and small fragments.

An important concept for the study of rings is the so-called Roche limit, which defines where an orbiting object can hold itself together under its own gravity. For example, a shovelful of sand in empty space will evolve into a



Voyager *images revealed that two of the three strands in Saturn's thin, outermost F ring are twisted and braided. The cause of this phenomenon has yet to be explained.*



Radial, spokelike features were seen crossing the ringlets of the B ring at nearly right angles. These features, which scatter sunlight in the manner of small particles, may be associated with electrostatic discharges.

spherically shaped object. But if the sand is orbiting close to an object such as Saturn, the grains closer to the object will tend to orbit faster, and the sand will spread out, first into a ring and then into a disk. At some distance from Saturn the two effects balance, and a pile of sand orbiting there would just barely hold itself together under its own gravity.

The Roche limit for Saturn is somewhere beyond the outer edge of the A ring. Inside this radius, a fragmented satellite would not re-form, and a cloud of dust grains would not aggregate. It is significant that the three known planetary ring systems, those of Jupiter, Saturn, and Uranus, are all within the Roche limits of their respective planets.

Outside Saturn's A ring but close to its Roche limit, there are at least five small satellites and a thin ring, called the F ring. The outer two satellites in this group share the same orbit and seem to change positions slowly so as to avoid collision. Two more of the satellites seem to "shepherd" the newly discovered F ring, one orbiting just outside this thin filamentary feature and one just inside it. Closer to Saturn, the fifth of these small satellites orbits just outside the A ring and seems to push it inward. These satellites and rings would be expected to interact and eventually collide. Indeed, the two coorbital satellites may be fragments from a collision long ago, but their orbits have evolved so that the two objects now avoid each other. Similar repulsive behavior also characterizes the interaction between the shepherding satellites and the nearby A and F rings. All of these satellites repel ring material, forcing it inward or outward, away from their orbits. This repulsion seems paradoxical, since the force of gravity is attractive. Such apparent paradoxes, however, are common in orbital mechanics; forces tend to have effects that are opposite to expectations based on everyday experience. For example, a force that acts in the direction of motion causes an orbiting body to move outward, where it orbits more slowly. A backward force eventually causes the body to orbit faster.

Thus, near the Roche limit this tendency of objects to avoid each other seems to interfere with the process of aggregation or reaggregation of individually orbiting bodies. Farther out, the constraints of orbital motion are less important than mutual attraction, so the aggregating effect predominates. In general terms, this is why the regions well outside the Roche limits are so empty. During the final phase of planetary formation, bodies there collided and stuck to one another, held together by their own gravity. The large satellites that remain in these empty regions must have swept up all the original material. The same sweeping process seems to describe the formation of the planets in our solar system from the original gas-dust cloud that was orbiting the sun during its formation.

Another curious feature is the radial spoke pattern that appears in the middle of the B ring, crossing its circular ringlets at nearly right angles. Like everything else in the rings, the spokes orbit Saturn, but they change shape, disappear, and re-form with each orbit. They scatter sunlight in a manner characteristic of small particles, those with sizes comparable to the wavelength of light. Electrical forces can be important for these particles, and so the spokes may be associated with the unusual radio signals detected by *Voyager*. The available evidence suggests that the spokes are related to electrical dis-



The top half of this composite photograph shows Saturn's rings as seen from the northern, or sunlit, side. The bottom image shows the same rings viewed from the southern, or unlit, side. The thick, opaque portions of the rings appear bright when viewed from the north and dark when viewed from the south. Conversely, the thin, semitransparent parts of the rings appear dark when seen from the north and bright when seen from the south. These images were made by Voyager 1 *in November 1980, when the spacecraft was approximately 1,898,000 miles from Saturn.*

charges, in which charge built up by the motion of ring particles through Saturn's magnetic field suddenly flows radially. The sparks created by the electrical discharges would be made visible by the motion of small particles out of the ring plane. Right now, it is not known whether the spokes are just another curious feature of Saturn's rings or whether the associated electrical forces play an important role in ring structure and history.

Electrical forces have also been invoked, partly in desperation, to explain another puzzling phenomenon, namely the intricate structure in Saturn's thin F ring, located just outside the A ring. The F ring contains three intermittent strands, two of which appear to be twisted. The instantaneous shape of the strands does not follow a simple orbital trajectory, so perhaps the whole pattern of kinks and braids orbits Saturn together. But then why doesn't the structure spread into a more conventional flat ring? Once again, hidden satellites embedded in the ring structure may provide the answer. Electrical forces may also be important, since much of the F ring structure is revealed by scattering from small particles.

Moving outward from the rings and small satellites, we encounter the larger satellites Mimas, Enceladus, Tethys, Dione, Rhea, Titan, Hyperion, and Iapetus. Except for Titan, whose diameter is 3,000 miles, all have diameters from 180 to 900 miles; all these satellites have densities close to that of water and are at least partly covered by water ice. Considering their small size and similar compositions, the surfaces of these satellites are surprisingly different. Mimas has a single large crater, with a diameter one-third that of the satellite. The impact of the collision that created the crater must have come close to breaking the satellite apart and was probably capable of melting a portion of the crust, causing substantial resurfacing. The absence of intermediate-sized craters probably indicates that at least one such resurfacing occurred after the final heavy bombardment during satellite accretion. Enceladus was not visited by *Voyager 1*, but viewed from across the Saturn system it appears to be almost featureless. It is also the brightest of the icy satellites. Tethys has a density almost equal to that of water. A long deep valley on the surface of the satellite implies geologic activity at some time in the past. Dione and Rhea both have bright, wispy markings on their dark, trailing hemispheres, the "protected" sides in their orbital motion around Saturn. These markings suggest that a low-density material, probably ice, was forced up through fissures in the surface. Bombardment of the leading hemispheres has since removed the markings from the front sides. Dione has a low overall crater population, with a flat, plainslike surface that must have come after the heavy bombardment phase so as to cover any preexisting cratered terrain.

Basic questions about these five icy satellites are, Why do they have such low densities (implying that they are mostly water ice)? and Why are they so small in relation to Jupiter's four Galilean satellites? The answers may lie in the difference in mass between Jupiter and Saturn. Saturn, being less massive, did not contract during its formation as soon as Jupiter, and so may have incorporated more of the late-arriving satellite material. Jupiter, contracting sooner, may have left more satellite material in orbit. Also, Saturn's early temperatures were never as high as Jupiter's, so that water was not evaporated away as it was close to Jupiter. These ideas are supported by computer models of a collapsing cloud of planetary material.

Saturn's giant satellite Titan is a unique object. Larger than our moon, it is the only satellite in the solar system known to possess an atmosphere. Its bulk density is consistent with a rock-ice mixture. The surface of the satellite is entirely obscured by a dark haze of extremely small particles. Before *Voyager* got there, the only gas known to be in Titan's atmosphere was methane (CH_4). The satellite's surface pressure and possible other gaseous constituents were unknown. The "slowing down" of *Voyager*'s radio signal as the spacecraft passed behind Titan made possible a determination of surface pressure. Infrared and ultraviolet spectra taken by *Voyager* established the abundance of gases. Titan's atmosphere turned out to be mostly nitrogen (N_2), like the earth's. The mass of an air column at the surface is more than one-tenth that on Venus and over ten times that on the earth. The speed and direction of the winds are unknown, but there is a faint pattern of colored clouds arranged in bands.

It is remarkable that all planetary atmospheres, including Titan's, are made primarily of the same four elements: carbon (C), hydrogen (H), oxygen (O),

and nitrogen (N). The differences are due mainly to the mass of the planet and its proximity to the sun—in other words, its temperature. The giant planets—Jupiter, Saturn, Uranus, and Neptune—retain all those four elements, including abundant amounts of hydrogen, and so the other three elements appear as methane (CH_4), water (H_20), and ammonia (NH_3). The terrestrial planets and Titan, by contrast, are not massive enough to retain hydrogen, which is the lightest element and therefore tends to escape. With oxygen available in the form of water, the terrestrial planets converted carbon to carbon dioxide (CO_2). On Titan water is frozen and inert; therefore, carbon must have combined with itself to form hydrocarbons. These condense to form the dark haze particles that fall to the surface. As on the terrestrial planets, nitrogen remains in the atmosphere as N_2 but no water or oxygen enters the picture. Methane gas could condense to form snow and rain on Titan, however, and liquid methane oceans could conceivably exist at the surface. In this sense, methane is the "water" of Titan.

Thus Titan followed an evolutionary path different from that of the earth, largely because of its much lower temperatures. Mars and Venus also had different evolutionary paths, again because of temperature. Current belief is that the earth is probably the only object in the solar system capable of holding liquid water, and therefore probably the only object where life could have evolved.

Hyperion and Iapetus complete the list of Saturn's "regular" satellites, those in circular orbits all in the same plane. They seem to be icy objects, like the inner five, and are also smaller than massive Titan. Iapetus is curious because of the fivefold difference in brightness between its bright, leading hemisphere and its dark, trailing hemisphere. Again, water ice is a candidate for the bright material, which has the reflectance properties characteristic of ice. Saturn and Jupiter also have small "irregular" satellites in huge, inclined, eccentric orbits. Theory suggests that these are captured objects, as distinct from the inner satellites in their flat, circular orbits. The former group are loosely bound to their parent planets, and their present orbits could have evolved after the formation of Saturn. The regular inner satellites must have formed with Saturn in nearly their present orbits.

Saturn itself provided some nice data for the *Voyager* spacecraft. The colors in the atmosphere are more muted than those of Jupiter, and there are fewer large, oval structures such as the Great Red Spot. But the banded cloud pattern is prominent, and the associated winds are remarkable. Winds are measured relative to Saturn's internal rotation, which we can sense by looking at the magnetic field. Winds at the equator flow eastward at more than 1,000 miles per hour. Jupiter's equatorial winds are only one-quarter this speed. Other differences between the two planets are not so great, making the difference in wind speeds hard to explain. Both are fluid objects, with no solid surfaces for winds to rub against; hence it is easy to imagine high winds on both planets. There is currently a debate over how deep the winds go, that is, whether they extend through the interior to the core of the planets or are confined to the thin layer where sunlight is deposited and radiation is emitted. This is a debate between astronomers and meteorologists over whether the giant planets resemble stars more than they resemble earth.

A curious feature of the winds on Jupiter is that turbulent eddies contribute energy to the east–west currents, not the reverse as one might expect. The ed-



This photograph, taken as the Voyager *spacecraft traveled past Saturn and away from the sun, shows the planet as a crescent, with its shadow falling on the rings. The dark, narrow band in the rings is called the Cassini Division. The lower part of the crescent is visible through this band, or gap.*

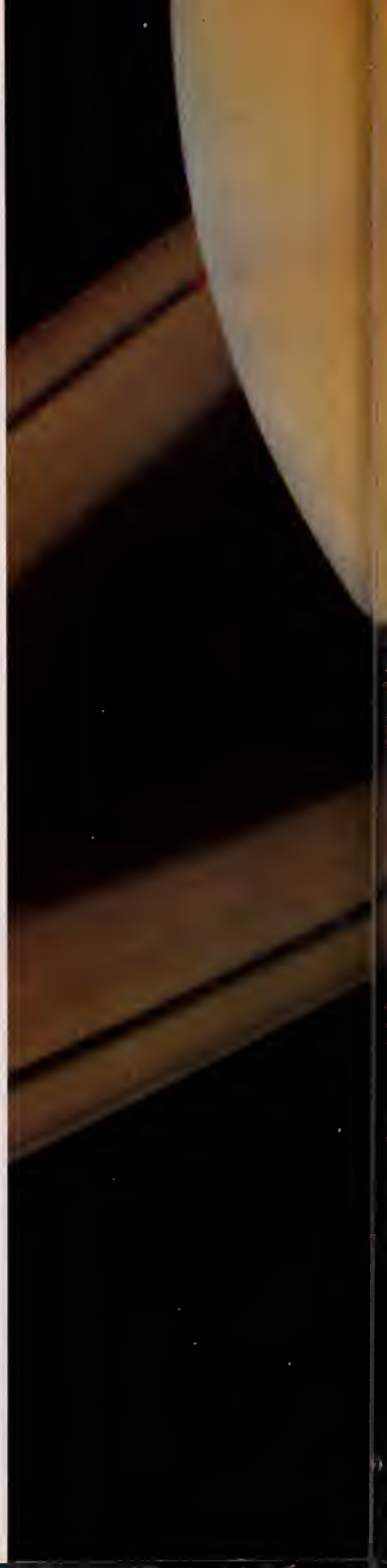
dies must get their energy from buoyancy, derived either from internal heat or sunlight. This backward transfer of energy from chaotic eddies to organized currents is also observed in the earth's weather patterns, although it is a minor feature of the total energy cycle. *Voyager* measurements show that on Jupiter, however, this backward transfer is a major part of the energy cycle. Saturn's eddy winds are more difficult to measure, the eddies themselves being harder to see. Scientists hope that Saturn will yield its secrets for *Voyager 2*, which has a more sensitive imaging system and is being programmed to make these important observations.

Besides making wind measurements *Voyager* also measured the atmospheric composition and total energy output of Saturn. Here another difference from Jupiter emerged, one that challenged scientists' understanding of the formation and evolution of these gas giants. Both Jupiter and Saturn radiate more power than they absorb as sunlight. The excesses come from the interiors of the planets, and theoretical models have been constructed to explain them. The models start with a hot ball of hydrogen, helium, and other elements in the appropriate abundance ratios. (To arrive at Saturn's present bulk density, one is constrained to start with mixtures that resemble the sun's.) Once the mass has cooled for 4.5 billion years—the solar system's age measured from radioactive decay in meteorites—the energy output in the model can be compared with the measured output. For Jupiter, the computed value agrees with observation. For Saturn, however, the computed value is too low.

Thus the planet generates more energy than can be accounted for by the simple cooling and contraction of a homogeneous mixture of solar composition. Another energy source is needed. Fortunately such a source exists and had been predicted before *Voyager*. Saturn, being less massive, is cooling faster than Jupiter, and today its interior is colder than Jupiter's. At some time, calculated to be about 2 billion years ago, Saturn's internal temperatures dropped below a critical point where helium condenses at the surface of the planet's fluid core of metallic hydrogen. As with a terrestrial air mass that is cooled below the saturation point, droplets form and then rain. These helium raindrops fall great distances inside Saturn and release heat by rubbing against the hydrogen fluid as they fall. Averaged over 2 billion years, the energy released if half the helium were to condense would just about explain the excess heat unaccounted for by simpler models. Because Jupiter cools more slowly, the critical point at which helium condenses is only now being reached in the interior of that planet.

Thus helium rain provides an extra energy source for Saturn but not for Jupiter, in agreement with the observed energy outputs of the two planets. Additional verification comes from the observed abundances of helium in the two atmospheres. *Voyager* measured 6 percent helium molecules on Saturn, 10 percent on Jupiter. The solar value would be 11 percent if the hydrogen were to combine into H_2, as on the giant planets. The lower helium abundance in Saturn's atmosphere implies a higher abundance in the core, as would be expected if helium rain had been falling for 2 billion years. The raindrops form about halfway to the center of the planet, where the pressure is millions of atmospheres. Yet the entire outer envelope loses its helium uniformly because it is stirred by convection. Therefore, the depletion of helium in Saturn's atmosphere reflects quite accurately the helium that has condensed at deeper levels throughout the history of the planet.

Finding this explanation for Saturn's extra internal heat is comforting to those who try to understand the solar system's formation and early history. It is axiomatic that the planets formed simultaneously 4.5 billion years ago. The initial composition of the material resembled that of the early sun, but was modified close to the sun by high temperatures. The gravitational energy of the formation event warmed all the planets, but only the most massive objects have retained this energy to the present day. Jupiter and Saturn now seem to fit this picture. It is not an improbable story. Similar events can be seen happening elsewhere in the galaxy today. The inference is that our solar system is not an unusual place. The conditions from which life evolved may have occurred on many of the billions of stars in our galaxy. □



Two of Saturn's large satellites, Tethys (above) and Dione, show up clearly against the blackness of space in this image made at a distance of eight million miles.





Imagine a camera that lets a dream



take shape as you watch.



One that lets you create



One that moves as close as 10.4 inches



or catches the fire of hot pink...



the cool shades of green...



One that can capture your fancy



or time expose the play of light.



Imagine 35 mm features

Shouldn't you own the only camera

Reproduced from original unretouched Time-Zero photographs ©1981 Polaroid Corp. "Polaroid," "SX-70," Time-Zero, and "Supercolor"



or observe with new eyes.



One with through-the-lens viewing



to let you frame precisely.



the hard edge of shadows in the sun.



One that lets you focus on a smile



or a sunset—automatically.



with the experience of an instant.

POLAROID SX-70

The only SLR instant camera. The fully automatic Polaroid SX-70 AutoFocus. See your dealer for the original chrome and leather model, or the new, economical Model 2.



in the world that can do all of this?

Not a static African import, the art of the Maroons has a history of development in South America. The shoulder cape, below, worn by a man, was sewn using colors and a patchwork style popular earlier this century.



Antonia Graeber



Art of the Rain Forest

Descended from escaped slaves, the Maroons of Suriname have drawn on their diverse African past and their unique New World experience to create a way of life rich in artistic expression

by Sally Price and Richard Price

Three women are sitting and working in an open-sided hut under a palm-leaf roof. Carefully patterned arrangements of scar tissue create sharp, raised accents on their bodies, and their skirts and waist ties make splashes of color against the earthen floor. Among them, they are producing designed manioc cakes, an elaborate hairdo, carved calabash bowls, and decorative calf bands, casually combining individual artistry, mutual cooperation, and lively aesthetic discussion.

The ancestors of these women were Africans sold into slavery in the Dutch colony of Suriname in South America. They escaped into the rain forest just north of Brazil, where they fought wars of liberation for 150 years. In the 1760s, a full century before the general emancipation of slaves in Suriname, these so-called Maroons (also known as Bush Negroes) won their freedom from the colonial government. By that time they had succeeded in building new societies and cultures that epitomize the remarkable resourcefulness of Africans and their descendants everywhere in the Americas. Today, there are six Maroon tribes in Suriname, speaking variants of two main languages. (The word *maroon* derives from the Spanish *cimarrón*, a word originally used to refer to domestic cattle that had taken to the hills in Hispaniola; by the early 1500s, however, it had come to designate the slaves who escaped from captivity in plantation colonies throughout the Americas.)

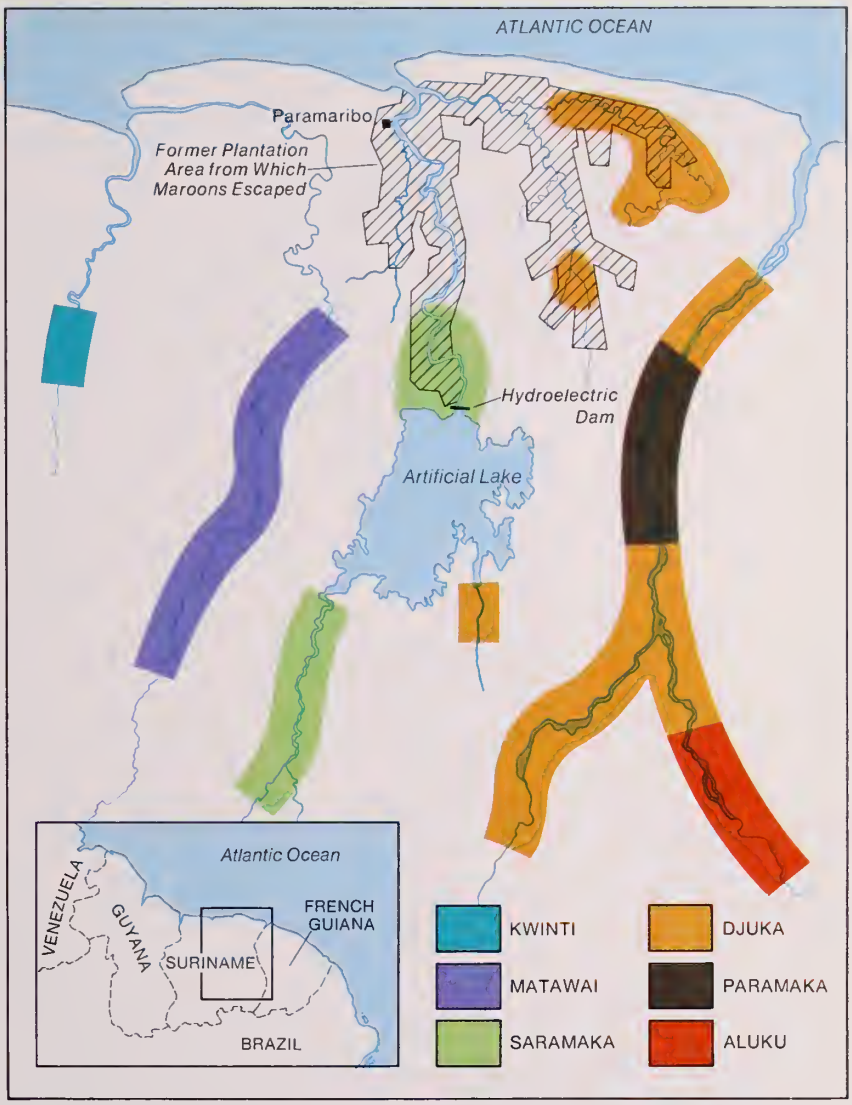
Even in the informal gathering of these three women, the pervasiveness of art in everyday Maroon life is unmistakable. One woman has brought a supply of manioc flour and set up a large round griddle over a barely smoldering fire. She is baking large, dry cakes, which in the coming days will be broken in pieces, dipped in water or broth, and eaten. The second woman sits on a handsomely carved stool with a clean, wet, hemispheric calabash shell on her lap and a collection of broken bottle pieces in a scrap of cloth on the ground. Next to her, the third woman sits on an old cloth on the earthen floor, her legs outstretched and a bottle on her lap; with a sharpened umbrella rib she is crocheting a pair of cotton calf bands for her husband, using the bottle as a form to create an evenly circular band.

The first woman spreads her manioc flour deftly over the dry griddle, draws her fingers over the entire surface to form decorative patterns, and carefully sifts a thin layer of flour over the top. While each cake bakes, she works on a hairdo for the woman with the calabash. Standing behind her seated friend, she sets up a network of parted sections and braids each section as part of an overall design. The braids around the face protrude forward and are secured with hairpins shaped out of scrap aluminum wire; those to the back are linked together; and a long, tightly braided line of hair runs between.

The woman with the calabash, well known in the village for her sense of design in this decorative art, is marking several designs as a favor to the woman sitting next to her, who will later finish

A special exhibition, Afro-American Arts from the Suriname Rain Forest, will appear at the American Museum of Natural History, October 28, 1981, to January 22, 1982. Organized by Sally Price and Richard Price, with the cooperation of the Museum of Cultural History of the University of California at Los Angeles and the support of the National Endowment for the Humanities, the exhibition presents the full range of Maroon arts in the context of this people's African heritage and their life and history in the New World.





The Maroons live along rivers in central and eastern Suriname. The Djuka, Aluku, and Paramaka tribes speak variants of one language, while the Saramaka, Matawai, and Kwinti speak variants of another.

executing the bowl carving herself. As she works, she constantly rotates the prepared shell between her hands, trying to remember the details of a particular design she is trying to reproduce, and adjusting the position of the calabash so that she can cut each curved line. She discusses with the woman sitting at her side the design they want to replicate, and finally, when neither can recapture just how its appendages were curved, settles on a new version, which she later decides is even better than the first.

The third woman, working steadily around the calf band, enlists the advice of her friends concerning the width of the red and yellow stripes that form its center. As the three of them work, their conversation alternates between village gossip and discussion of their artistry.

We see in this gathering the influence of aesthetic considerations in all areas of Maroon life, from food preparation and meal service to clothing and grooming. We see the active participation of Maroons in a wide range of artistic media. And we see the Maroons' enjoyment of discussions focused on artistry and aesthetic evaluation. As the anthropologist Melville Herskovits noted fifty years ago, "Bush Negro art in all its ramifications is, in the final analysis, Bush Negro life."

Both graphic and performing arts have been elaborately developed by the Suriname Maroons. Visual media include woodcarving and painting, different techniques of calabash carving, designs baked into manioc cakes, colorful textiles made from narrow strips of commercial cloth, embroidery of many kinds, appliqué, decorative scarring of the body (cicatrization), hairdos, the carving of designs on imported metal spoons, and the manufacture of carved aluminum combs, decorative beadwork, colorful yarn tassels, crocheted calf bands, and a kind of knitted multicolor ribbon.

The performing arts play an equally extensive role in village life. Specialized dances are performed by mediums believed to be susceptible to possession by various gods, and there are many secular dances, each enjoyed in a particular social context. Distinctive song styles are used in the whole range of Maroon ritual events, from complex funerary rites to the domestication of a new god believed to possess people, as well as in communal labor such as felling trees or hauling logs, and in many casual or even solitary settings. It is rare to walk through a Maroon village without hearing someone singing. Drums are used singly or in various combinations to accompany different secular dance forms; to announce, supervise, and comment on the proceedings of large public council meetings; and to communicate with each kind of possession god, with other deities and spirits, and with the ancestors. And there are other musical instruments as well—bells and wooden trumpets, a stringed instrument made with a gourd, and a "finger piano." Finally, the verbal arts—folk tales, play languages, proverbs, oratory, speeches made by possessed mediums, and prayer—exhibit a wide range of stylistic modes in the tribal languages and keep alive a large number of distinctive esoteric languages that are used only in special ritual settings.

The breadth of Suriname Maroon art extends considerably beyond the wide variety of formal arts. Even manufactured items imported from China, Japan, the Netherlands, the United States, and elsewhere—including guns,

An engraving by William Blake for an eighteenth-century narrative by John Stedman depicts a slave guiding troops in pursuit of escaped slaves. The Maroons eventually won their freedom from the Dutch colonists.

Richard Price

Richard Price



Another of Blake's engravings in Stedman's narrative depicts the whipping of a female slave. Stedman, a soldier who fought rebel slaves, wrote sensitively about slaves, their masters, and the Maroons.

buckets, trade cotton, bottles, lanterns, and so on—have formed a substantial contribution to the aesthetic life of Suriname Maroon societies since the very earliest days of their formation. The men who buy these objects at the end of lengthy stints as wage laborers outside the tribal territories (in coastal Suriname, French Guiana, and elsewhere) select their purchases very carefully. In addition to basic utilitarian features, the different perfumes of soaps, the slightly varying finishes and proportions of tin lanterns, the colors of different cloths, the fringed edgings on cotton hammocks, and the curve of the handles on aluminum pots are all subjected to scrutiny. Once brought back to the home villages and distributed to wives and kinsmen, the chosen articles undergo the same kind of exacting evaluation. The most successful purchases are displayed with pride, serve as the inspiration for popular songs, and are understood to reflect the care and aesthetic sense of the man who bought them. Many of these objects are then further embellished in the villages; for example, metal spoons from French Guiana may be elaborately incised with designs found also in local woodcarvings, and pots are often marked with simple carvings or decorated with red tape.

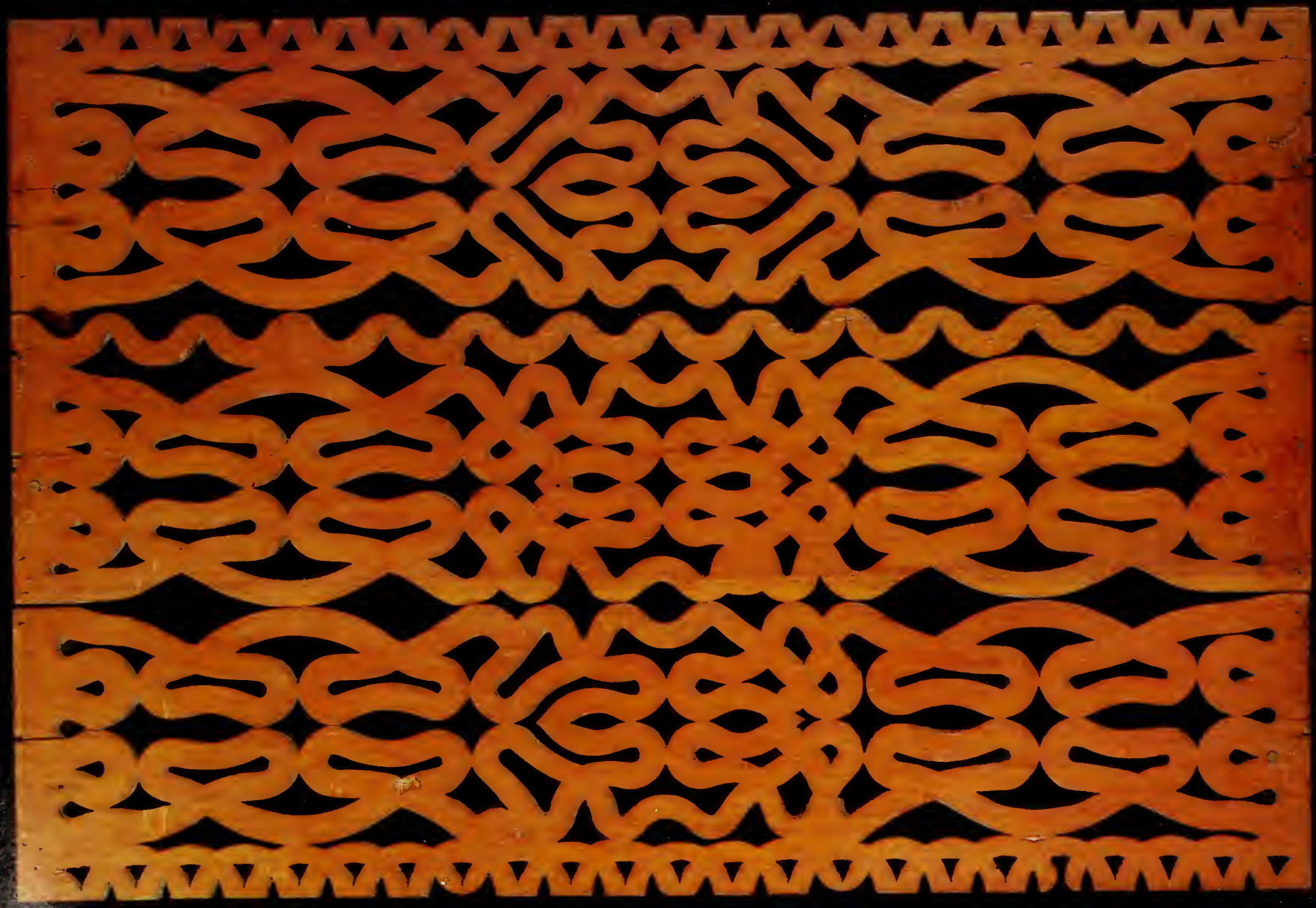
Besides their variety, the arts of the Suriname Maroons are unusual in the extent to which they have traditionally been practiced by the entire population. For example, all men carve a wide range of objects as gifts for women—from canoes and house fronts to combs and food stirrers—and all women produce elaborate patchwork and embroidered textiles to be worn by men. This is in decided contrast to many African societies, where only certain individuals are trained to be artists, producing and selling sculptures, carvings, and woven textiles. (In some African societies the role of critic is also a recognized specialization.) Suriname Maroons, however, expect *all* adults to be active artists and assertive critics.

Children are fitted into this world of artistic production, performance, and connoisseurship from a very early age. Regardless of individual temperament, they all need the skills and aesthetic framework that will enable them to participate fully in Maroon life. From the time children can stand, they are frequently and enthusiastically encouraged to dance to the rhythm of hand-clapping or thigh slapping. Six-year-old girls begin to learn the principles of narrow-strip textile composition by fashioning three-piece aprons out of scraps of cloth too small for other uses, and boys carve crude wooden objects, such as combs and small paddles, at an equally early age.

A significant aspect of Maroon artistry is the central role it plays in social institutions. In discussing art with us, Maroons very often made reference to the social uses of the objects—most frequently enumerating the decorated objects that would be presented in particular situations, such as the rites for newborns and adolescents, funeral ceremonies, and the celebration of a man's return from an extended trip to coastal Suriname. People rarely discussed particular woodcarvings without referring not only to the artist but also to the woman for whom the woodcarving was made and the details of the couple's relationship at the moment each piece was given. Just as dance,

This interior openwork door was carved by a Saramaka man about 1930. Maroon architectural decoration includes carving, painting, and wood inlays. Often, the entire façade of a house becomes a work of art.

Antonia Graeber





Maroon men carve calabashes only on the outside, using knives and chisels to create a textured design. Calabashes made by women are decorated on the inside with free-form shapes carved with pieces of broken glass.

song, and drumming are conceptualized in terms of the social events for which they are most frequently performed, the meaning of artistically designed objects are bound up with the social moments for which they are intended.

Together with fish and game, garden and forest products, and Western imports, artistic objects contribute to the fulfillment of a variety of social relationships, from voluntary formal friendships to ties of kinship and marriage. Most important among these are the relationships between a man and his wives. Woodcarving, calabash carving, textile arts, and decorative body cicatrization are generally intended to serve in the ongoing campaign of every adult to attract spouses and lovers and to maintain their affection over time.

A husband's return from the coast is one of the many regular contexts in which gifts, including artwork, are presented and reciprocated. A Maroon woman provides the following description of this custom, in which a man's sisters serve as intermediaries, presenting the gifts he has brought back to his wife—salt, kerosene, kitchenwares, and other imported goods. After the trunks holding the gifts have been opened,

> everyone really celebrates in that house! Then the woman says "Listen to me!" and she jumps up. She'll load an enamel basin with some calf bands. She'll load up some narrow-strip textiles. She'll put in some cross-stitch embroidery. She tells her sisters-in-law, "Take these to the man for me." And they'll set everything on their heads and carry it off to the man. The woman will stay in her own house, rejoicing over the presents, while all the others go off to the man's house. Then the man will say, "Well, here's something for you to take over to the woman." This last present can be anything that he's brought back from the coast—any kind of dishware, maybe an aluminum water jug. . . . They bring it over and say, "Woman, don't you see? Here's something that your husband sent over for you." The wife will jump right up. She'll grab the one thing that she hasn't yet given him and, right there, she'll give it to her husband's kinswomen. She'll always have one thing held back, to give him separately. It could be some cross-stitch or an embroidered neckerchief, or whatever. "Take this thing here. Go drape the man with it for me." After her gift is presented, shouts will ring out *wooooooo*. . . . "My goodness! The woman has really pulled the goods to the ground!" That means that she hasn't been shamed by having made too little to reciprocate his gifts properly. That's what's known as "pulling the goods to the ground."

Many visitors to Suriname have envisioned Maroon arts less in the context of their contemporary setting than in the context of their African roots. The villages of the rain forest have often been seen as a "little Africa in America" and Maroon arts as direct "African survivals." The title of an article on Maroons that appeared in the pages of this magazine more than forty years ago was quite explicit: "Africa's Lost Tribes in South America: An On-the-Spot Account of Blood-chilling African Rites of 200 Years Ago Preserved Intact in the Jungles of South America by a Tribe of Runaway Slaves." And more recent visitors have even claimed that Maroons have maintained a society "that is 'more African' than much of Africa is today." Behind this view lies the myth that so-called primitive societies exist outside of history, that they are by nature strongly resistant to change, and that they develop only when other, "more advanced" societies impinge upon them.

In fact, societies differ enormously in their attitudes toward change and in the extent to which they exhibit an internal cultural dynamism. The societies of the Suriname Maroons, like the vast majority of societies in pre-twentieth-century West and Central Africa, have *always* been highly dynamic. Our fifteen years of research on Maroons—in historical archives, museums, and Maroon villages—has persuaded us that creativity, innovation, and artistic development from one generation to the next lie at the very heart of their cultural life. Far from being static leftovers from seventeenth-century Africa, Maroon societies have continually developed as their members played and experimented with the artistic heritages of their ancestors, adapting them creatively to their changing lives.

We now know that the original Maroons produced little decorative woodcarving or textiles; their clothing was extremely simple and their houses and furnishings largely unembellished. It was only over time that the relatively crude woodcarving of the mid-nineteenth century developed into the twentieth-century art that has struck many outsiders as "African looking." And the multichromatic Maroon narrow-strip textiles that so closely resemble



Michael K. Nichols

The pots and pans in a Saramaka woman's house are kept proudly on display. Obtained by men who travel to coastal areas to work for wages, such imported items are selected with a critical eye.

Richard Price



Enjoying a snack of oranges, two Saramaka boys turn the peels into fanciful face masks. Children are drawn into the world of artistic production, performance, and connoisseurship at an early age.

West African *kente* cloth became popular only during the present century, as a replacement for a very different textile art of embroidered designs that earlier Maroons executed in red, white, and either black or navy. Paints, introduced in a few conservative colors less than 100 years ago, have since come to play a central role in the arts of the eastern Maroons. And calabashes, which until the mid-nineteenth century were decorated only on the outside surfaces by men, began to be carved on the insides by women in an entirely new decorative style executed with bits of broken glass.

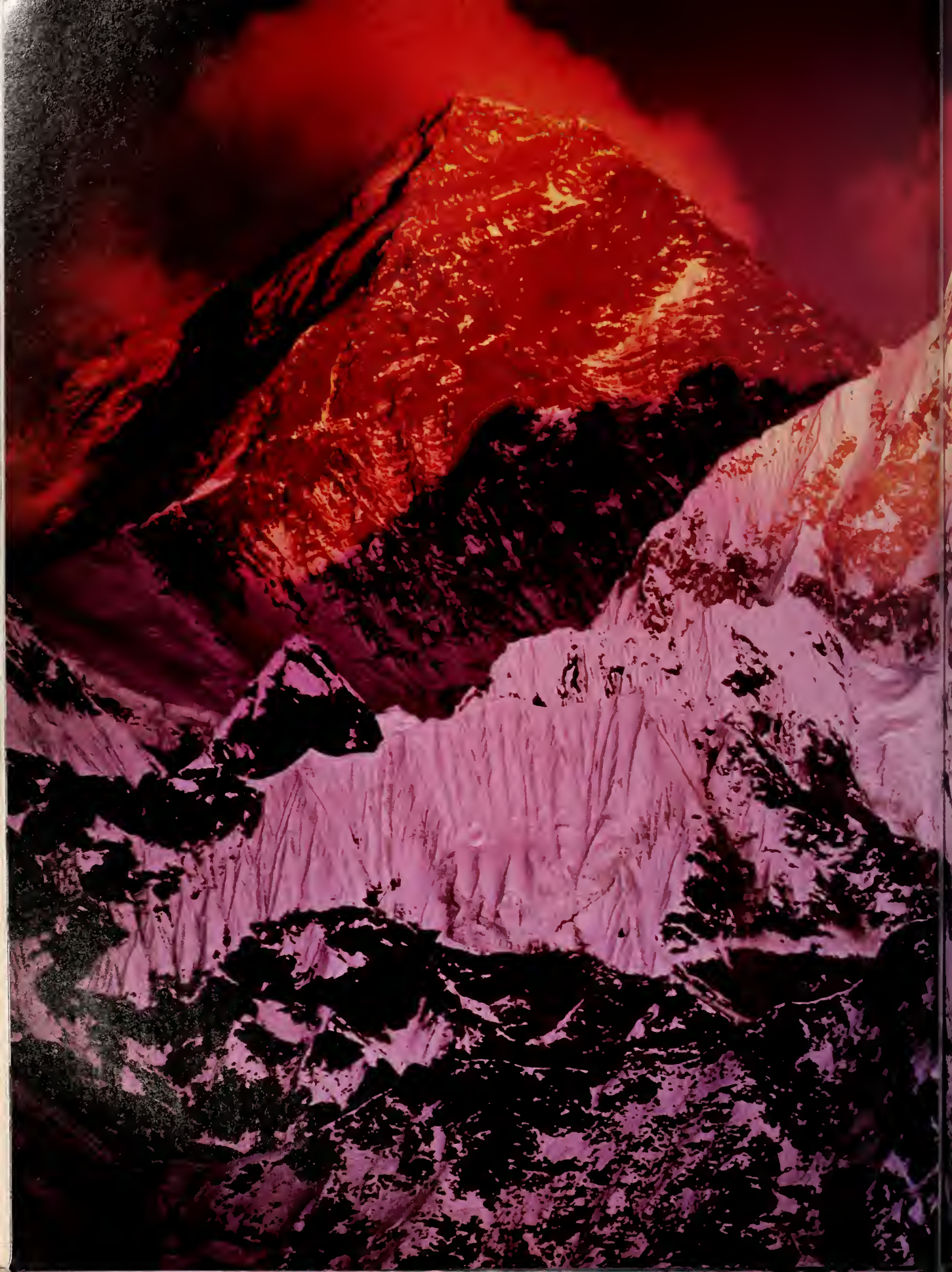
In light of this history of development and change, one of the main puzzles in the study of Maroon art is how to explain visible resemblances between the arts of the Maroons and those of West and Central Africa. Given the stylistic developments that have repeatedly led Maroon arts in new directions, how has the cultural legacy of Africa been expressed over the centuries? The answer lies more in the continuity of aesthetic ideas than in the direct transmission of African forms from one generation to the next. The present-day Maroons are the descendants of people who were separated from family and friends, stripped of personal possessions, overworked, and tortured. The first Maroons were challenged to form new ways of life in an unfamiliar environment and in cooperation with other Africans who spoke languages different from their own. The survival of their communities is, in itself, evidence of their remarkable inner resources. And the rich traditions of music, dance, folklore, and the visual arts that have evolved in their lives reflect the special strength of their aesthetic and spiritual sensitivities and interests. The Maroons were not in a position to continue such African traditions as sculpture, carving in ivory, and weaving. But they did succeed in carrying on many of the fundamental ideas that had contributed to the character and meaning of those arts in Africa—ideas about symmetry, color contrast, and syncopation, and above all, the understanding that art has a place in all aspects of daily life.

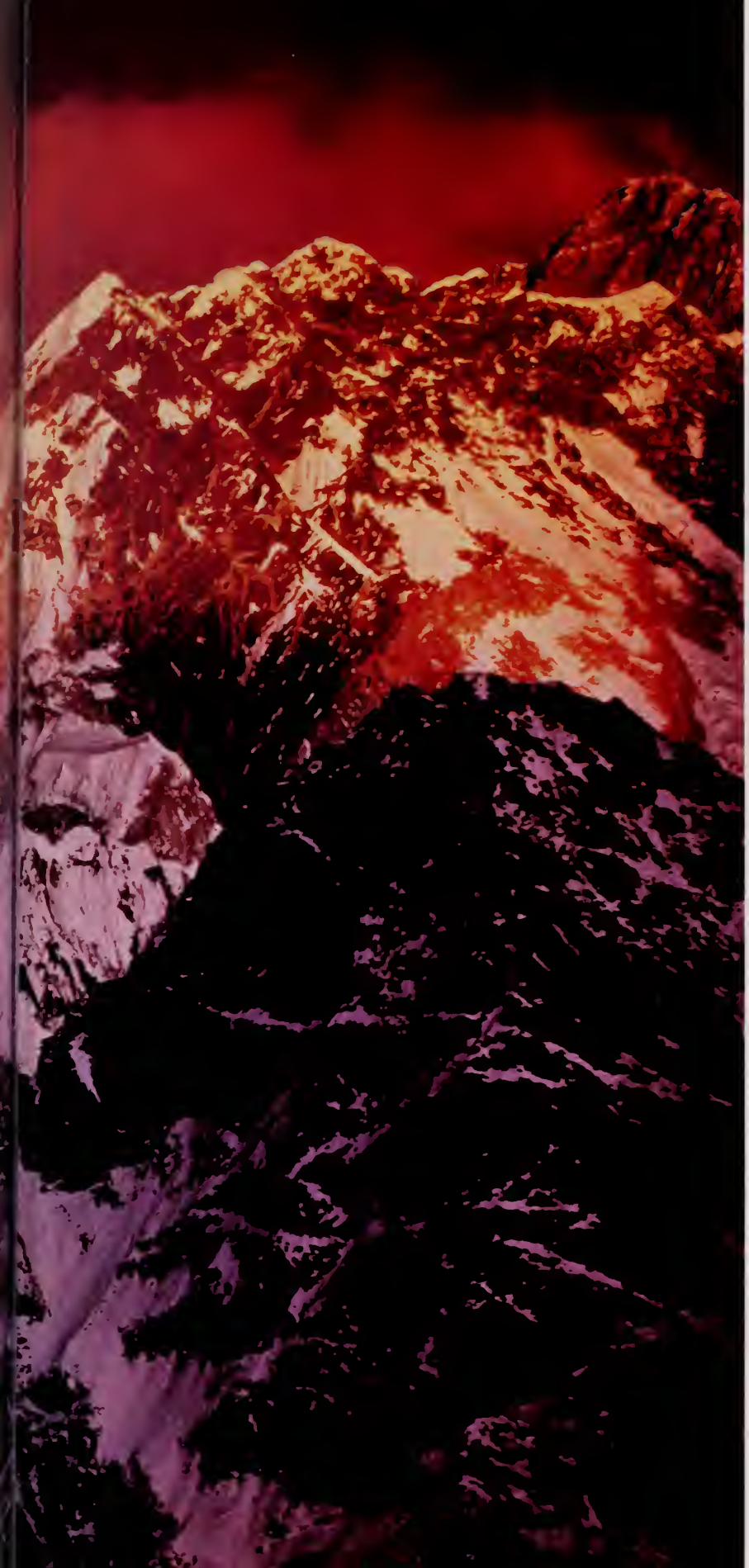
Even under the harshly repressive conditions of slavery in Suriname and during the century-long period of guerrilla warfare against the Dutch colonists, these people still made use of opportunities for storytelling, dancing, drumming, and singing. They made choices about the way they walked, carried their babies, and wore their hair. They expressed preferences in the arrangement of their house furnishings, the mending of their clothes, the serving of their meals, the layout of their gardens, and countless other aspects of daily life that did not require the specific resources of more formally elaborated artistic media. In this way, aesthetic ideas were passed on and applied inventively to the changing artistic materials of each generation. Forged in an inhospitable rain forest by people under constant threat of annihilation, the arts of the Suriname Maroons stand as enduring testimony to Afro-American resilience and creativity. They reflect the remarkable exuberance of the Maroon artistic imagination, expressing itself within the rich and broad framework of African cultural ideas. □

Carved between 1915 and 1920, this Saramaka stool was embellished with brass tacks, a popular ornamentation at the time. Woodcarving, the most widely acclaimed Maroon art, is practiced by all the men.

Antonia Graeber







The Tibet Connection

Having discovered some new details of far-flung climatic linkages, meteorologists are reexamining historic weather maps and revising their computer models

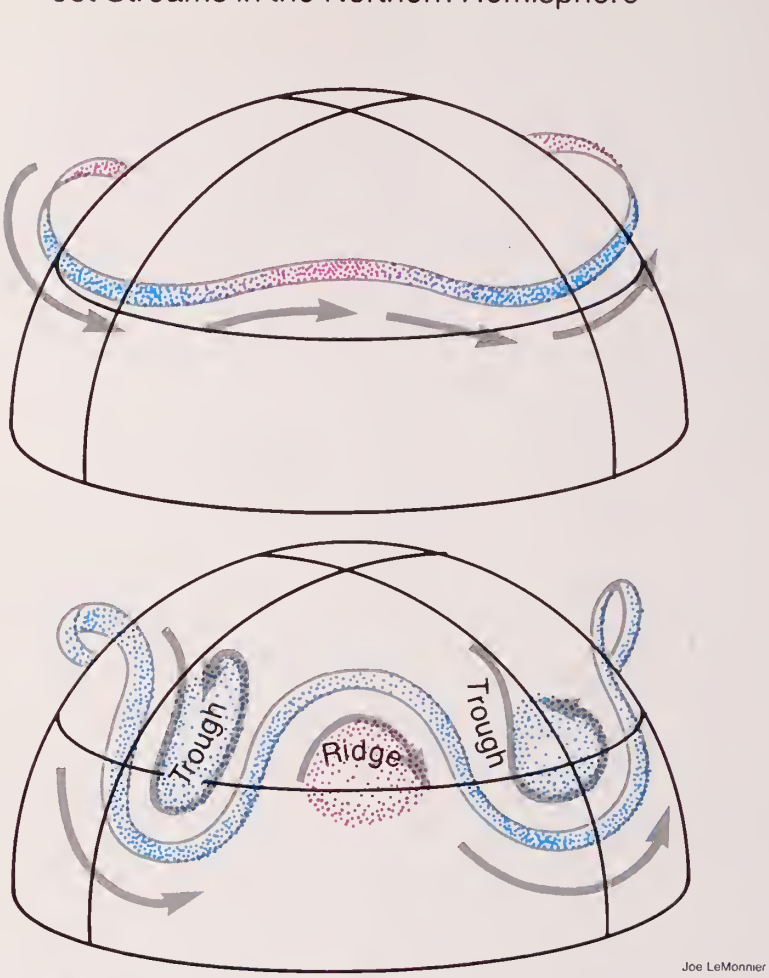
by Elmar R. Reiter

Weather may seem to be just a local affair, but in fact, its events are not self-contained. Rather, each is part of a highly complex global system involving such variables as temperature, air pressure, wind, humidity, and precipitation. The bonds that join these atmospheric conditions are the jet streams—large, high-speed air currents that circle the earth in ever changing patterns at altitudes of five to thirty miles. Jet streams in the troposphere (the innermost layer of the atmosphere, extending up to about ten miles) travel at velocities of between 60 and 400 miles per hour, moving blizzards, rainstorms, and squall lines, and dragging lower-lying air packages across the face of the land, thereby affecting local weather conditions. Over North America the jet streams usually shift northward into Canada during the summer and migrate as far south as the Gulf of Mexico during the winter, but their behavior is not always easy to predict.

Erratic meanders in jet stream systems are closely related to some of the

Mount Everest, at the left, the world's highest peak, is on the Tibet-Nepal border. Rising 29,028 feet, it is part of the Himalayas. To the right is Lhotse, 27,923 feet high. Sheltered behind the 1,500-mile-long curving Himalayan range is the Tibet plateau. Because the Himalayas do not lie at right angles to the airflow in the upper troposphere, jet streams can circle around them.

Yoshikazu Shirakawa/Image Bank



The normal jet stream pattern, upper drawing, differs from the strong wavy pattern, lower drawing, that correlates with regional temperature anomalies. Ridges tend to have warmer than normal temperatures (red), while troughs of the jet stream match regions of cold temperature anomalies (blue).

recent weather anomalies in the United States. For example, during the winter of 1980–81, the jet streams, instead of moving south, remained along or to the north of the Canadian border in the Rocky Mountain region; to the east, they strayed over the New England region. That brought to Colorado and neighboring states a lack of snow, severe drought conditions, an abundance of sunshine, and unseasonably warm weather, while the northeastern seaboard states were swept by arctic air masses and snowstorms. This situation was nearly reversed in the winter of 1979–80, when New York State's Lake Placid, scene of the Winter Olympics, was starved of snow but record amounts fell in the Rocky Mountains under that winter's main jet stream flow.

The changeable behavior of the jet streams from one year to the next is not confined to the United States. Wayward shifts of the jet streams have also been associated with crop failures in the USSR and droughts in China during the past four to five years. These events raise the question of what causes jet stream aberrations.

Despite the great altitudes at which they circulate, jet streams are themselves affected by terrestrial features, such as mountain ranges and high landmasses, and by such variables as changes in land- and sea-surface temperatures. In the Northern Hemisphere the principal geographical features ultimately responsible for jet stream meanders are the Rocky Mountains, the Himalayas, and the Tibet plateau in Southeast Asia.

Global atmospheric airflow at midlatitudes in and below the jet streams has a west-to-east orientation. The Rocky Mountain chain, whose highest peak is 20,320-foot Mount McKinley in the Alaska Range, extends some 3,000 miles from northwest Alaska southward to central New Mexico. The Rockies lie almost exactly perpendicular to the airflow pattern, presenting a formidable barrier. Because the mountains are so extensive, the air cannot easily move around them, and so it goes over them. The Tibet plateau, however, is a different kind of obstacle. On the south, the plateau is sheltered by the Himalayas, which extend in a broad curve some 1,500 miles and include peaks that rise more than 25,000 feet; on the north it is sheltered by the similarly long Tien Shan mountain chain, with peaks exceeding 20,000 feet. The average elevation of the plateau itself is more than 14,750 feet.

Regardless of its name, the Tibet plateau is not an expanse of level land but a corrugated area of mountains and valleys, containing the headwaters of several large rivers and many saltwater and freshwater lakes. The minimum elevation of the valleys is 12,000 feet. Despite the enormous height of the Himalayas and of the plateau itself, these barriers, unlike the Rockies, do not lie perpendicular to the airflow pattern nor are they insuperably extensive. Air can therefore flow around them. But this deflection of airflow gives rise, in turn, to large meanders in the global jet streams. And these meanders set the stage for the "Tibet connection" with weather and climate in the Northern Hemisphere, a phenomenon of far-reaching implications that can affect Indian monsoons, cause North American summer heat waves, and that may be linked to the unusually cold North American winters of 1976 through 1979. That such a linkage exists is evident from weather maps.

If daily tabulations of global atmospheric airflow and pressure distributions for any month in any year are averaged, the "wiggles" associated with traveling waves in the airflow and perturbations that cause the daily variability of local weather disappear. What is left is the stable wave pattern caused primarily by the topography of the earth's surface. In regions without significant mountains, that is, over the Atlantic and Pacific oceans and over Europe, the observed mean monthly flow patterns are probably due to resonance in the effects of the two aforementioned major mountain obstacles.

If the physical barriers of mountain ranges and a high plateau were the only factors acting on atmospheric airflow,

Elmar R. Reiter



Shepherds tend their flocks on the treeless, almost barren plateau. In the background are the Transhimalaya Mountains of central Tibet.

seasonal variations in weather patterns would follow the same course year after year. But recent climate anomalies show that this is not the case. Obviously, other factors must be involved in generating large meanders in the jet stream flow. The prime candidate in effecting these changes is the process that supplies the upper atmosphere with heat energy from below.

When the air layers on their eastward flow rise over the Rocky Mountains, they are squeezed vertically by the stable stratosphere above them and are curved anticyclonically, that is, in a clockwise direction. This establishes a high-pressure, warm-air system over the Rockies and the Great Basin. In the lee of the Rockies, the warm air expands, creating a low-pressure cyclonic, or counterclockwise, system containing cooler air masses. Jet streams are affected by the horizontal contrast of temperature and pressure below them. Therefore, this combination of anticyclonic and cyclonic airflow in the lower atmosphere alters the path followed by the high-traveling jet streams.

In the case of the Tibet plateau, temperature again seems to be the controlling variable. The plateau is colder in winter and warmer in summer than the "free" atmosphere at the same elevation above sea level over the adjacent land areas and oceans. A cold Tibetan plateau is frequently invaded and dominated by cold, low-pressure systems that are associated with cyclonic, or counterclockwise, airflow. The juxtaposition of cold air over Tibet and warmer air over India, to the southwest, represents a horizontal temperature contrast between the two regions and results in horizontal pressure contrast, with low pressure over Tibet and high pressure over India. This pressure differential tends to be at a maximum near the tropopause level of the atmosphere (at approximately 30,000 to 40,000 feet), where a strong jet stream skirts the Himalayas.

A law of physics dictates that in the Northern Hemisphere, when the wind is at your back, low pressures with cold air must be to your left and high pressures with warm air to your right. (This rule, derived originally from observations of low-level airflow, also applies to the jet streams.) Accordingly, the streams flowing around the Tibet plateau in winter move in a west-to-east direction. But when the sun starts to heat the plateau in spring, and the air over Tibet becomes warmer than the air at the same altitude over India, the plateau ceases to serve as a "refrigerator," causing a cyclonic curvature of the jet stream, and begins to act like a giant, elevated "hot plate."

During the spring and summer, heat from the land rises and is mixed into the turbulent planetary boundary layer of the atmosphere. (This layer is the part of the atmosphere, about three-quarters of a mile thick, on the average, that lies immediately above the earth's surface.) The layer tends to be thicker over warm surfaces than over cold ones. Hence a warm region acts on the flow of the lower atmosphere in much the same way that a wide mountain range acts on the jet streams, causing the airflow to skirt anticyclonically—in a clockwise-curving arc.

As the heating of the high Tibetan landmass continues, the horizontal

In wintertime, cold air settles over the Tibet plateau, causing the formation of a low-pressure system with a cyclonic, or counterclockwise, airflow in the upper atmosphere at altitudes of about 30,000 feet. The effect is especially pronounced when there is prolonged and heavy snow cover on the plateau. South of the Himalayas, a west- to east-flowing jet stream is established and dry winter weather prevails over India and Southeast Asia.

Joe LeMonnier



temperature and pressure differences between Tibet and India are reversed from what they were in winter. In accordance with the above-stated law, an anticyclonic curvature is introduced into the prevailing jet stream, causing it to flow from east to west over the southern slopes of the Himalayas. This change in flow takes place in spring, and the jet stream reverts to its winter pattern in fall, the two reversals coinciding with the start of summer and winter monsoon seasons, respectively, in India.

Anomalies in ocean temperatures cause airflow phenomena similar to those seen on land and can also lead to the same kinds of feedback mechanisms in weather patterns. A number of scientists have noted that large areas of warmer than normal sea-surface temperatures in the North Pacific and North Atlantic tend to coincide either with persistent or recurrent high-pressure patterns in the atmosphere over these regions. On the other hand, large cold-water anomalies in the North Pacific and North Atlantic have been found to be associated with low-pressure systems in the atmosphere.

Low-pressure regions are associated with stormy and cloudy weather, whereas high-pressure regions usually have fair and relatively calm weather. In stormy weather, the ocean is stirred up by high waves, and cooler water from below rises to the surface, thus perpetuating below-normal sea-surface temperatures that, in turn, attract more stormy weather. A big low-pressure region over the North Pacific during January 1977, for instance, coincided with a large cold-water anomaly. The tendency for prevalent high-pressure patterns to develop over warm water diminishes the turbulent mixing of ocean water. Cold water, which is heavier than warm water, rises only when forced to by the wind. Thus high-pressure patterns keep the sea-surface layers relatively warm. Sunshine under relatively cloudless skies also contributes its share to keeping the ocean warmer than normal.

The thermal effects just described are usually of much smaller amplitudes than the deflection of airflow around Tibet and over the Rocky Mountains. Nevertheless, the jet stream wave patterns that are mainly set up by the Rocky Mountains and the Tibet plateau do seem to be affected by sea-surface temperatures. For example, in the eastern United States the cold winters of 1976–77 and 1977–78 occurred when the surface waters of the central North Pacific were abnormally cold but the surface waters off the west coast of the United States were warmer than usual. With this temperature distribution, the central North Pacific was characterized by stormy, low-pressure weather and a stronger than normal ridge—an extended high-pressure system—settled over the west coast regions of the United States and Canada, including the Rocky Mountains. The eastern side of this strong, persistent ridge served as an effective conveyor belt, ferrying cold arctic air into the central and eastern United States.

The 1980 summer heat wave in the south-central United States was marked by a persistent anticyclone in the same area. Meteorologists suspect that this phenomenon was triggered by the Rocky Mountains (which the jet stream tends to cross with an anticyclonic curvature). The anticyclone's persistence was most likely caused by the combined effects of an unchanging pattern of large-scale airflow waves between Tibet and the Rockies, surface temperatures over the Pacific, and feedback from the heat wave itself. The dry and hot soil of the south-central United States acted on the atmosphere as a giant furnace, heating up the lower troposphere and thereby extending the deflecting effects of the Rockies on the tropospheric airflow patterns farther to the east and southeast than is normally the case.

Snow cover can also bring about feedback that can cause certain weather patterns to become either persistent or repetitive, resulting in large seasonal anomalies. An example of such a feedback effect is the extended low-pressure region, or trough, that often settles over the central United States downwind of the Rocky Mountains. Such troughs create ideal conditions for the development of winter blizzards over eastern Colorado. These storms ordinarily move in a northeasterly direction, blanketing the country with several inches of snow. The snow blanket reflects the sun's radiation back to space, keeping the underlying soil from warming up. As a consequence, cold air moving down from Canada remains cold for extended periods and can cause repeated blizzards. Thus an extensive snow blanket reinforces the trough originally produced by the barrier effect of the Rocky Mountains. These combined effects contribute to lengthy periods of below-normal temperatures.

Snow cover in Tibet also comes into play. Normally, Tibetan winters are dry, resembling winters in the central Rocky Mountains. The average annual

Joe LeMonnier



As the Tibet plateau heats up during spring and summer, it warms the air, giving rise to a high-pressure system with anticyclonic, or clockwise, circulation in the upper troposphere. South of the Himalayas, this serves to establish an east- to west-flowing jet stream, bringing summer monsoon rains to India and Southeast Asia.

precipitation over wide areas of Tibet is less than sixteen inches and comes down mainly in the form of summer showers. Nevertheless, extensive winter storms occasionally bury most of the Tibet plateau under a lasting blanket of snow, and these snowfalls can have a significant effect on precipitation in India.

In April the plateau usually starts to act as an elevated heat source for the atmosphere, helping to generate a high-pressure system in the upper troposphere over Tibet. This system becomes the dominant feature of the Tibetan summer, and its strength, to a large extent, controls the Indian summer monsoon. The barrier and thermal effects of the Tibet plateau work together to produce the rain that hundreds of millions of people on the Indian subcontinent and in southeastern China rely on to sustain their crops. The sequence of weather patterns in that part of the world tends to go awry, however, when winter snows in Tibet are unusually deep and consequently resist the melting warmth of the sun.

The dazzling white of the snow surface reflects the sunlight and slows the warming of the soil. Under such conditions the Tibet plateau becomes a sputtering, ineffective "hot plate" over which the atmosphere's monsoon-sustaining anticyclone can build only with difficulty. If this Tibetan high-pressure, anticyclone system is weak and is established late in the season, the drenching rains of the Indian summer monsoon will also be late, and the rainy Indian summer will be interrupted by prolonged spells of drought with devastating effects. Food prices in India and Southeast Asia may climb, millions of people may go hungry, and the stability of governments may be threatened.

If winter snow cover in Tibet can influence the amount of rainfall of the subsequent Indian summer monsoon in this manner, the obvious question to ask is, What causes the variability in Tibetan snow cover? In other words, what lies behind this Tibet connection?

One possible answer relates to the amount of solar heat the plateau reflects to space, and that, in turn, depends to a large extent on the amount of snow that falls on the plateau. When the plateau is widely blanketed under snow, it reflects more of the incoming solar energy back to space than when it is covered with dry grass and barren rock, and this difference in reflectivity produces different effects on the atmosphere. In an ordinary winter, the plateau receives a minimum amount of snow—only a few inches. When the occasional extensive snow cover does fall, the snow, in contrast to the usual barren soil, keeps the atmosphere colder, promotes more storm activity, and increases the chance of additional snowfall. Such conditions disturb the usual position of waves in the jet stream flow and produce such untoward effects as one foot of snow in Tibet in the winter of 1972. But what caused the Tibetan snowfall in the first place?

In studying weather maps from 1960 to the present, I discovered almost by accident that variations in Tibet's winter snow cover matched surprisingly well with sea-surface temperature anomalies over the central North Atlantic during the same periods. When the North Atlantic was excessively warm in the winter, there appeared to be little winter snow in Tibet. A warm North Atlantic tends to attract a persistent high-pressure system, which as it extends into fall, promotes warm, dry weather in Europe and Asia. (This is the kind of weather vintagers love, especially in the Bordeaux area, and as one might expect, there was also a positive correlation between the quality of Sauterne wine grown in that region of France and warmer than normal temperatures in the central North Atlantic.) On the other hand, warm-water anomalies in the Atlantic during autumn and winter promote a trough and ridge pattern over Europe and central Asia that can send Siberian winter storms into Tibet, dumping excessive amounts of snow in that country.

Having found this correlation, I began to search for other possible Tibet connections. A link has already been demonstrated among the delays, weaknesses, and shifts in the Tibetan summer high-pressure system, the Indian summer monsoon, and sea-surface temperatures in the Atlantic. But there seems to be a tie-in with the Pacific Ocean as well. When there are strong summer monsoons in central India and a well-developed high-pressure system over Tibet, the frequency of typhoons in the west Pacific seems to be lessened. When there are many typhoons in the Pacific—some of them bringing excessive rains and flooding to eastern China—the Indian summer monsoon tends to be dry.

In the 1920s, when India was still under British control, British researchers pointed out the existence of a "southern oscillation" in surface air pressures over the land and the sea in the regions between the South Pacific and the Indian Ocean. When the air pressure at Djakarta in Java and in the Indian Ocean was above normal, for example, the Indian monsoon tended to be weak, and the sea-surface pressure in the

South Pacific was below normal. These early studies also suggested a Tibet–Pacific Ocean connection with the Indian monsoon. The intriguing linkages did not stop there, however.

Recent research indicates a correlation between higher than normal air pressure in Djakarta, a drier than normal Indian monsoon, and more than the usual amount of rain in the equatorial Pacific. Under these conditions, the usually strong trade winds may be diminished, and the expected upwelling of nutrient-rich cold water off the coast of Peru, containing plankton on which anchovies feed, may be replaced by a warm, saline water mass. This infrequent event, which tends to arrive after Christmas and has accordingly been called *el niño* ("the child"), kills the plankton and drives away the anchovies, devastating the year's catch and disrupting the world market for those who depend on anchovies as their chief source of protein. (This disruption is, in turn, felt in other protein markets such as the soybean market.)

Thus warm waters off Peru and along the equatorial east Pacific occur simultaneously with higher than normal rainfall in the equatorial Pacific and drier than normal Indian monsoon weather. But warmer than normal Peruvian coastal waters also seem to coincide with warmer than normal water in the usually cold California current, which flows north to south, wells up along the California beaches, and moves water southwest of Baja California into the tropical Pacific. This pattern of sea-surface temperatures correlates with enhanced typhoon activity in the North Pacific, which as we have shown, tends to coincide with an abnormally weak Indian summer monsoon. Some of the loops and circles of the Tibet connection can in this fashion be seen to close.

Still another item of more than curious coincidence has been found. In winters with a strong *el niño* warming of the ocean off the coast of Peru, the stratosphere (the layer of the atmosphere directly above the troposphere) also warms dramatically over the polar regions of the Northern Hemisphere and the normal westerly winds in that atmospheric layer break up into large, wavy patterns. This phenomenon has been called sudden stratospheric warming. Such major warming events apparently occur only in the Northern Hemisphere and seem to be confined to *el niño* winters when the northeastern Pacific also tends to be warmer than normal. Warm waters off the Pacific coasts of the United States and Canada tend to promote the establishment of a strong and persistent high-pressure ridge in the atmosphere over the western seaboard and the Rocky Mountains. This atmospheric flow pattern has a decisive impact on the stratosphere, causing the nearly circular flow there to break down into a wavy pattern of large amplitudes and further strengthening the tropospheric high-pressure ridge. Conditions in January 1977 provided an example of the development of such a ridge, resulting in a major stratospheric flow breakdown and adjustment and in stratospheric warming over the Arctic regions, while the eastern United States shivered in the grip of arctic air.

The foregoing discussion demonstrates the Tibet plateau's far-reaching effect on large-scale wave patterns in the atmospheric airflow over the Northern Hemisphere. The connection between surface temperatures in Tibet and the Indian monsoon has already been mentioned.

Land-surface temperature is, of course, dependent on the amount of heat energy in the form of solar radiation absorbed by the plateau. It is inversely proportional to the plateau's albedo, that is, the percentage of energy it reflects back to space. Fresh snow has an albedo of more than 80 percent, which means that only 20 percent of the sun's radiation energy is available to melt the snow and heat the underlying soil. Dry sand has an albedo of 18 percent, grass-covered ground ranges between 15 and 25 percent, green forests between 4 and 6 percent. A rule of thumb is that the darker a surface looks to the eye, the more radiation energy it absorbs, and the lower its albedo, or reflectivity, becomes.

We know that an increase in the albedo of the Tibet plateau due to extensive snow cover tends to diminish the rainfall over India several months later. In the past, however, some factor other than snow may have affected the albedo of Tibet. Traveling through that region today one cannot help but notice the absence of forests. The Chinese have recently planted trees in and near the villages, but they have to be protected from foraging animals by mud walls. Everywhere one sees people and beasts of burden moving down the mountainsides and across great distances, carrying huge loads of branches and freshly cut junipers for use as firewood. That sight raises the question of whether Tibet's river valleys have been denuded over the centuries by humans in search of fuel. Poor soil conditions, made worse by erosion, are ubiquitous and may have been caused, at least in part, by deforestation.

At present about 1.5 million people eke out a living in barren Tibet, but according to some accounts more than 10 million people inhabited this region during the Middle Ages. Was the land barren then? If so, how did the inhabitants keep warm? It does not seem plausible that the firewood necessary to support a population of more than 10 million could have been carried across the Himalayan passes or through the river gorges of southeastern Tibet, especially since wheeled traffic was hardly known before the recent arrival of the Chinese. Did this large population engage in a massive deforestation of the Tibetan highlands that drastically increased the plateau's albedo?

The answers to these questions are not known, but we can guess that an increase of albedo over widespread regions, from the 4 to 6 percent typical of forested areas to the 15 to 25 percent of grassland terrain that now characterizes the valleys of Tibet, could have produced noticeable effects in the form of decreased summer precipitation over India. Because recorded history does not provide us with easy answers, we have been forced to look for them in computer models of the atmosphere's circulation patterns. Mathematical models are currently being designed to try to establish the Tibet connection in the form of a system of equations that may be useful in forecasting monsoon weather over India. One of the questions these models will test is, Would the climate in Pakistan, India, Southeast Asia, and eastern China, where the existence of millions of people depends on the abundance of monsoon rains, be enhanced by bringing the forests back to Tibet? □

A native of Xigaze, a town almost in the center of Tibet, hauls hard-to-find juniper, freshly cut to use as fuel. Centuries ago, the plateau may have been wooded but it has long been denuded. To improve the fuel situation in Tibet, the government of the People's Republic of China has an active tree-planting program in the province.

Elmar R Reiter



Mastodon Memories

In the Hall of Late Mammals at the American Museum of Natural History, four mastodon and mammoth skeletons parade single file down the center aisle. The most famous of this quartet is the third skeleton in line. Called the Warren Mastodon after the scientist who eventually acquired it, it is the remains of a beast that wandered along the shores of the Hudson River perhaps ten or twenty thousand years ago. The animal came to an untimely end in what is now Orange County, New York, by venturing too far into a soggy bed of peat and shell marl.

The skeleton was discovered in 1845 on Nathaniel Brewster's farm in East Coldenham. The summer that year was dry and hot, and many small ponds receded, leaving peat bogs that the local farmers began digging up to fertilize their fields. On the Brewster farm one large pond had dried up, and the enterprising farmer hired a gang of workmen to cut the peat and marl and spread it on his fields. The men had dug about three feet into the bog when one of them struck something hard. Further digging revealed a four-foot-long skull with a pair of gracefully curving ivory tusks. Brewster called in A.J. Prime, a doctor living in nearby Newburgh, who sped down to the Brewster farm in his carriage to supervise the excavation. As the workmen dug, they gradually exposed the beautifully preserved skeleton of a mastodon, standing upright just as it had sunk into the mire thousands of years ago. The skeleton's position gave an indication of the unfortunate animal's final moments: its legs were thrust forward and slightly apart, and its skull was tilted upward as if straining for a last breath of air.

Unlike most mastodon and mammoth bones, which turn black over time, the bones of this mastodon were only slightly stained, giving them a rich brown coloration—"like old human bones," one paleontologist wrote. Although its flesh had decayed and vanished, the contents of its stomach remained. In one of the numerous scientific articles he later wrote, Prime described the discovery of the stomach:

> In the midst of the ribs, embedded in the marl and unmixed with shells or carbonate of lime, was a mass of matter, composed principally of the twigs of trees broken into pieces of about two inches in length, and varying in size from very small twigs to half an inch in diameter. There was mixed in with these a large quantity of finer vegetable substance, like finely divided leaves; the whole amounting to from four to six bushels. From the appearance of this, and its situation, it was supposed to be the contents of the stomach; and this opinion was confirmed on removing the pelvis, underneath which, in the direction of the last of the intestines, was a train of the same material, about three feet in length [and] four inches in diameter.

The delighted Prime had the bones carried to the Brewster barn, and neighbors recall him working for weeks in the gloom of the barn, carefully fitting and wiring the bones together. In classic nineteenth-century fashion, the resultant mounted skeleton went on tour, stopping at small New England and New York towns, where it drew crowds of amazed viewers. The original tusks had crumbled on exposure to the air, so the mastodon was fitted with a large pair of fakes.

The Warren Mastodon was only one find in a series of discoveries ranging back to 1705, when Governor Dudley of New York wrote to that famous Puritan Cotton Mather about several mastodon bones and teeth that had been found near Albany. In 1782, the first Orange County mastodon bones were unearthed on a farm outside Newburgh. George Washington made a special trip to see these bones during his sojourn at Newburgh in the winter of 1782–83. In 1802, a complete skeleton on John Masten's farm near Newburgh was excavated by Charles Willson Peale and his sons Rembrandt and Titian. For years, Peale exhibited the mounted skeleton in his museum in Philadelphia, and then apparently the entire creature was lost.

The Warren Mastodon was the fifth complete skeleton found in Orange County. In *An Outline History of Orange County*, published one year after that find, Samuel W. Eager wrote a glowing account of mastodon discoveries in the area:

> We cannot, without disrespect to the memory of a lost but giant race, and slighting the widespread reputation of old Orange as the mother of the most perfect and magnificent specimens of terrestrial animals, omit to tell of the mastodon. Contemplating his remains as exhumed from their resting place for unknown ages, we instinctively think of his great and lordly mastery over the beasts—of his majestic tread as he strode these valleys and hilltops—of his anger when excited to fury—stamping the earth till trembling beneath his feet—snuffing the wind with disdain, and uttering his wrath in tones of thunder,—and the mind quails beneath the oppressive grandeur of the thought, and we feel as if driven along by the violence of a tornado. When the pressure of contemplation has subsided and we recover from the blast, we move along and ponder on the time when the mastodon lived,—when and how he died, and the nature of the catastrophe that extinguished the race; and the mind again becomes bewildered and lost in the uncertainty of the cause. . . .
>
> Were they pre-Adamites, and did they graze upon the fields of Orange and bask in the sunlight of that early period of the globe?—or were they antediluvian, and carried to a common grave by the deluge of the Scriptures?—or were they postdiluvian only, and till very recent periods wandered over our hills and fed in these valleys. . . .

In 1846, John Warren, a professor of anatomy at Harvard College, bought the mastodon discovered on the Brewster farm for $5,000. He had it crated and shipped to Boston and hired N.B. Shurtleff to remount it for display in his small paleontological collection. A number of famous nineteenth-century scientists came to view the specimen, including Louis Agassiz and the English geologist Sir Charles Lyell. Apparently, Warren was not happy with Shurtleff's mounting, because three years later he hired a Mr. Ogden to dismantle and completely remount the skeleton. Ogden had his own ideas about what a fossil should look like, and he painted the bones with a thick





"It's life as usual in the big wildlife reserve nearby," says Orval Fouse, Supervisor, Utilities & Environmental Engineering at Gulf's Port Arthur, Texas, refinery. "The snow geese still spend a few months here each year during migration. The marshes around the refinery are still full of raccoons, otters, minks, muskrats, even some deer and bobcats.

"To me, that's very good news, because it means they're totally unaffected by the fact that, for the past 20 years, we've been refining what's called 'sour crude.'

"We call it sour because it contains a lot of pollutants. We have to take some sour crude when we buy oil overseas. Of course, we can't release those pollutants into the air. So Gulf spent millions of dollars modernizing this refinery to handle this type of crude. For 20 years now, we've been refining over 100,000 barrels of sour crude a day, and as you can see by the wildlife around here, the air quality is as good as ever."

We have prepared a brochure, "In Search of Balance," on the ways and means of balancing energy and nature. You may have a copy, free, by writing to Mr. William E. Moffett, Vice President, Public Affairs, Gulf Oil Corporation, Department SG, Box 1166, Pittsburgh, Pennsylvania 15230.

Gulf

Gulf people: energy for tomorrow.

© Gulf Oil Corporation 1981

"Can oil and wildlife mix? They do at Gulf's Port Arthur refinery."

Snow Goose (C. Caerulescens), photographed near Gulf's Port Arthur refinery by Dr. John Tveten.

layer of black varnish. Next he arbitrarily raised the rib cage and backbone two feet above the shoulder blades, thereby increasing the mastodon's height from nine feet to twelve. Finally he made a brand-new set of gigantic papier-mâché tusks, which swept outward in artistic but purely fictitious curves. In the small museum he had established at 92 Chestnut Street in Boston, Warren exhibited the refurbished mastodon along with his rapidly growing collection of mastodon remains from all over the United States and Europe. In 1906, after a respectable length of time had elapsed since Warren's death, the trustee of the collection wrote to Henry Fairfield Osborn, president of the American Museum of Natural History, and discreetly suggested that the entire collection "might be offered for sale under certain conditions." Osborn, who had had his acquisitive eye on the Warren Mastodon for some time, set out for Boston on the Friday afternoon he received the letter and traveled all night, arriving at the Warren Museum the next morning. Osborn reviewed its treasures with the trustee, Thomas Dwight. They chatted for a while and soon agreed on a price of $30,000 for the entire collection. On Monday, Osborn telephoned his friend J. Pierpont Morgan and asked him to give the Museum $30,000 to buy the collection; Morgan readily agreed, and the skeleton was dismantled and shipped back to its home state.

Before mounting the skeleton, Osborn wanted the black varnish removed. After a number of experiments, Museum technicians built a series of large vats and filled them with benzine in which the bones soaked for many weeks. A final scrubbing with alcohol brought out "all the purity and beauty of color that characterized the skeleton," according to Osborn.

Repairing the original tusks presented a more serious problem. These existed only as two boxes of fragments. The piecing together of the tusks took several months of painstaking and exacting work.

Adam Hermann, the preparator who mounted the skeleton for the Museum, spent a day riding an elephant in a zoo, feeling its shoulder bones and backbones with his hands to figure out how they were related. This information led him to calculate that the height of the Warren Mastodon should be nine feet two inches, and its length from skull to tail should be fourteen feet eleven inches. He posed the skeleton in a walking position, head held high, a reminder of the days, not so long ago, when mastodons roamed the Hudson Highlands.

Douglas J. Preston

Lectures for Adults

The popular fall lecture series will start in October. The lecture courses cover a wide variety of subjects in anthropology, archeology, art, and the natural sciences. The programs will include:

Asian Dancing. Three performances of Asian dance will be given in the Auditorium beginning Monday, October 19. They will be introduced and narrated by Beate Gordon, director of the Performing Arts Program for the Asia Society. *Korean Shaman Rituals and Mask Dances,* performed by Duyee Chang, is the first program in the series. On Monday, October 26, Suarti and Suarni Desar will perform *Balinese and Sudanese Dances,* and Endo Suanda will demonstrate *Sudanese Mask Making.* Concluding the series on November 2, *Eastern and Western Japanese Dance* will be performed by Sachio Ito and Saeko Ichinohe. The price for the three-evening series is $20; tickets may also be purchased separately.

Tibet: The Buddhist Tradition. Three speakers will discuss the culture and religion of this remote land, illustrating their talks with slides and film. Edwin Bernbaum, author of *The Way to Shambhala,* will begin the series of Thursday evening lectures on October 22 with *Hidden Valleys of the Himalayas.* Next, on October 29 and November 5, Franz Michael, professor emeritus of East Asian history and government at George Washington University, will lecture on the cultural history of Tibet. On November 12 and 19, Valrae Reynolds, curator of Oriental collections at the Newark Museum, will speak on Tibet's religion and art. Tickets for the series cost $30.

Audubon Nature Films. Four filmmakers will introduce and screen their latest films about the wildlife of four areas of North America. The first film is Dennis Holt's *Okefenokee, Land of Trembling Earth,* which will be shown on Tuesday, October 20. It examines the animal life of the largest virgin swamp in the United States. On Tuesday, October 27, Richard Kern will show his film, *Florida Cypress Sanctuary: Fishing Creek,* about the seasonal wildlife of this habitat. The third film, on Tuesday, November 10, is *A Naturalist Afield: Part II* by Karl Maslowski, a study of animal behavior in Yellowstone and Grand Teton National Parks. The last film, on Tuesday, November 17, is *Footloose in Newfoundland,* by Thomas Sterling, an exploration of Newfoundland's history, people, and culture. Tickets for the series are $25.

Other subjects in the lecture series are American archeology, wetland botany, and weaving—a total of seventeen courses will be given this fall. Prices range from $20 to $65. Contact the Education Department at the Museum for details and a course registration form.

Discovery Tours

C. Bruce Hunter will lead an in-depth Discovery Tour to the People's Republic of China, from October 24 to November 14, 1981. Limited to twenty-four participants, this intriguing tour focuses on the outstanding art and archeological sites of China. Highlights will include extended visits to Peking, Sian, Nanking, Shanghai, Datong, and Taiyuan.

Two other Discovery Tours to China are being planned for the spring and fall of 1982. For information regarding China programs and other exciting destinations, please write to Discovery Tours at the Museum or call (212) 873-1440.

Workshops for Young People

Five exciting courses this fall will help children explore the world around them. *Photographing New York,* taught by a social scientist and professional photographer, will show students how to take and develop pictures of New Yorkers at work and play. In *Exploring with the Microscope,* children will learn about a variety of cells and microorganisms. Other courses are *The World of Dinosaurs, Reptiles and Amphibians,* and *Human Origins.* The workshops start the weekend of October 25, and cost from $14 to $25.

Night of the Hunter

The Drama of the Universe, the current sky show in the Hayden Planetarium, will close September 14. *Night of the Hunter,* an exploration of the constellation Orion, opens Thursday, September 17.

Planetarium Courses

This fall adults and children can choose from a variety of courses in astronomy, meteorology, navigation, and aviation. Some examples are *Life Beyond the Earth,* which will explain why some scientists believe that intelligent life must exist elsewhere in the universe; *Meteorology,* an introduction to the atmosphere and weather forecasting; and *Cosmos,* based on Carl Sagan's television series. There are a number of basic astronomy courses for young people, including *Introduction to the Sky,* a study of stars and other objects in space. Classes begin at the end of September. For a free course catalog, call (212) 873-1300, ext. 206.

Microhistory

Through the Looking Glass, an exhibition tracing the development of the microscope from its most primitive form to the highly advanced models of the present day, opens in the Akeley Gallery on Wednesday, September 23. Examples from many periods will be on view, with illustrations depicting what could be seen through each. One exhibit deals with the sophisticated scanning electron microscope and includes a videotape showing what this $150,000 instrument can do.

Imported by The Paddington Corporation, New York, N.Y. 34 Proof © 1981



BAILEYS.
THE ORIGINAL IRISH CREAM LIQUEUR.

THE CREAM IS REAL. THE SPIRITS ARE REAL.
ONLY THE TASTE IS MAGIC!

Holy Places and People of India

What draws pilgrims to sacred sites and sacred people?

by Colin Turnbull

Apart from a few professional climbers, only the most devoted pilgrims seek out such inaccessible natural shrines as the Himalayan sources of the Jumna and Ganga rivers. Yet in more accessible places, such as Kashmir and Darjeeling, tourists experience the same sense of awe at nature's beauty. Shrines may be built at such sites, but at best, nature works its miracle of inspiring faith without any human help. Elsewhere, in places where the greatness of nature is less apparent, monuments and temples are built as witness to some suprahuman greatness. There is nothing special about the holy river Ganga at Varanasi (Benares); the countryside is the same flat expanse of farmland that follows the river's course throughout the plains. But at Varanasi, the river, which once it has descended from the northern mountains runs mainly from west to east, turns and briefly flows from the south back up toward the north. Every morning it seems as if all of India's millions descend the ghat steps in the sacred city of Varanasi and enter the water to perform *surya-pranam,* welcoming the rising sun and chanting the sacred *gayatri* mantra. At that time Varanasi is one of the most beautiful cities in the whole of India, particularly for the pilgrim. For the tourist, however, it may forever remain merely one of the dirtiest.

Grossly overcrowded, Varanasi is marked by disease and poverty; the most luxurious palaces have an unkempt and shoddy look about them, and the temples are no architectural wonders. What attracts pilgrims by the millions is something very human, rather than divine, but sacred nonetheless: the ancient history of at least three thousand years of uninterrupted faith that has permeated the city from its holiest shrines to its filthiest residential areas. In Varanasi, crime, poverty, disease, and sanctity walk together with confounding ease and assurance in a strangely inoffensive kind of mutual support. Man and man's unquenchable faith give the city this quality; the very squalor that would otherwise only repel is transformed into a honeyed bait that, throughout the ages, has attracted India's greatest, as both tourists and pilgrims.

Other holy cities have arisen in areas that have even less to offer by way of natural wonders than Varanasi, but have been chosen to become great political centers. One such city, Khajuraho, capital of the Chandela dynasty, reached its height in the tenth century. Today, out of some eighty-five great temples, only twenty-two survive. Khajuraho is now a dead city, a national park opened up and managed for the exclusive use of tourists attracted by the erotic carvings that seem to cover every square inch of the ornate structures. Most of these tourists, Indian and foreign alike, fail to visit the nearby village, which—taking pride in its sudden rise to fame again after centuries of neglect—has turned itself into one of the cleanest and most attractive villages in India. And surprisingly few of the foreign tourists take more than a second look at a temple that stands just outside the entrance gateway where you pay your admission fee, only a stone's throw from the first temple within the tourist compound. Although it looks much like all the others, this temple is alive. Anyone who climbs the long flight of stone steps as night falls will witness the worship of a gigantic, eight-foot carved stone phallus, or *lingam,* a form of worship that transforms what is politely referred to as erotic art from tourist pornography into a surging, massively powerful religious quest. The *puja* performed in the inner sanctum of that temple attacks all the senses at once; it transforms one's whole being in an experience that at first seems entirely physical, but that culminates in a gentle act of blessing, an offering of food and water, a touch of a finger on the forehead—so soft that only the eyes of the priest tell you it has been done. With all the evidence of erotica around, an objective observer might construe the *puja* itself as erotic, particularly at its loudest, when the temple drums seem to force the body to move, even to dance. Some tourists do indeed think so—from the outside steps. But a few, those who want to understand rather than just observe, climb the steps, enter the shrine, and find, to their surprise, that they are made as welcome as pilgrims and treated with the same respect. Shrines need people to bring them to life and give them meaning.

Another tourist resort that used to be a major pilgrim shrine is Mahabalipuram, on the west coast, south of Madras. Here as with the Chandela capital, Khajuraho, the faith that caused the temples and rock shrines to be built is mute, and the only form of worship is that practiced by tourists with their cameras. Yet not far inland is Kanchipuram, whose many temples, separated by miles of busy streets, are filled with pilgrims from morning to night, testifying to the magnitude and vitality of pilgrimage as a social institution. The temples also testify, in more ways than one, to the similarity between pilgrimage and tourism.

Each of the larger temples consists of five walled courtyards, laid out one within the other. Each wall is pierced by a huge gateway surmounted by a richly decorated *gopuram,* or "tower," which soars up into the sky. The towers lead the spirit upward as they lead the body inward, and the mood of the pilgrims is one of excitement and expectancy, precisely that of tourists arriving at their destination. There is an urge to accomplish, to see all there is to be seen, to do everything there is to be done. In some temples the outermost courtyard may be filled with attractions; in others it may just be a narrow empty space, somewhat like the moat surrounding a castle. On either side of the first gateway there are invariably stalls with vendors selling their wares: guidebooks to the temple, scriptures, writings by holy people associated with the temple, garlands of flowers to offer at the various shrines within. And, of course, there are guides everywhere, waiting like hawks for the unwary.

Most of the pilgrims pass on through an empty outer courtyard and enter the next *gopuram,* eager to get to the shrines. They jostle each other, joke and laugh, pose for photographs. But a few, in a more reflective mood, just stand on the inside, looking up at the next gateway, reading its intricately carved face as though it were a book, letting each image tell its story. And of these reflective pilgrims, a few will then begin the *parikrama,* or "circumambulation," of the outer courtyard, walking slowly in the prescribed clockwise fashion. Sometimes the outer walls are surmounted by a seemingly endless succession of carved bulls; otherwise there is nothing to look at except the bare stonework and the sky above. Like tourists, all the pilgrims have been drawn by the same outer objectives—to see the same sights, enjoy the same spectacles, participate in the same pleasurable activities—but each does it in his or her own way, each finding the essence that makes the visit worthwhile. Nevertheless, it would be a mistake to classify the pilgrim as religious and the tourist as secular. The tourists who, rather than going straight into a casino, stop to enjoy the gardens outside, might be said to be closer to a religious experience than those pilgrims who purchase a garland of flowers at the outer gate, head straight through to the innermost shrine, and so to speak, place their bet on the altar before doing anything else.

Nor should the various ritual observances that many pilgrims perform make it seem that they are exclusively devotional. The pilgrim slowly circumambulating the temple's first empty courtyard, quietly chanting the scriptures, may be just as excited as any tourist. Some may even have to work hard to keep their minds on the sacred and avoid the distractions of the many sideshows the larger temples have to offer. There is, for instance, a particularly arduous way of performing the *parikrama,* which really should be done in each courtyard until the central shrine itself has been reached. Prostrated full length, face down on the ground, arms outstretched, pilgrims inch their way upward and forward until they are standing where their hands had touched; then they prostrate themselves again. This practice, called *sashtanga danda pradakshina,* is not often seen. On the few occasions that it can be observed, however, it appears to be not a penance but rather a way of savoring the pleasure of pilgrimage to its fullest, of exhausting every possible delight before coming to the greatest joy of all, *puja* at the main shrine, which becomes a veritable ecstasy.

The more obvious enjoyments are many. In some inner courtyards there are huge pillared hallways that may be used as bazaars where shopkeepers sell replicas of the various shrines, colorful pictures of scenes from the Hindu mythology, icons carved from stone or sandalwood, rosaries, and other religious mementos that pilgrims take home, like tourist trinkets, to remind them of a special and sacred moment in their lives. But there are also things to take back to enrich normal, daily, secular life: clothing to be worn every day, shoulder bags in which to carry schoolbooks or the day's shopping, bright jewelry with not a trace of religious symbolism. All these serve as a reminder of sanctity, just as vacationers like to have something to remind them of their "holiday," a word that is, after all, derived from the Old English *haligdaeg,* or "holy day."

Some temples house elephants or other animals; many have whole areas filled with monkeys. The animals provide entertainment, and the elephants, in particular, are paraded frequently for the crowds to watch. (Once in a while elephants are hitched to enormous chariots that carry sacred images from the temple out into the streets.) There may also be bathing tanks or special wells from which, according to inclination and means, the pilgrim can drink or be sprinkled or thoroughly drenched with holy water. The temple as a place of entertainment is one of the

INDIA.
WHERE WE ARE
DIFFERENT.
WHERE WE ARE
THE SAME.



Meet men who walk in holiness



Our cities are exciting mixtures of the old and new

India. An unbelievable experience.

We are as different as you hope.

Come to us and view palaces, tombs, fortresses. Shop in brilliant bazaars. Enjoy our art, listen to our music, feel our dances.

You will see sights you've never seen, new colors and shapes. You will hear new sounds, taste new tastes.

But we have another surprise for you, too.

We are the same as well as different.

We can make you extraordinarily comfortable. You'll stay in modern, air-conditioned hotels. Play golf, tennis. Swim in cool pools.

And most of our people speak English.

Come to us on one of the many, many tours offered. We'll make you feel very different. And very much at home.

UNBELIEVABLE
INDIA

Please send me information on Unbelievable India NH9

Name

Address

City, State, Zip

GOVERNMENT OF INDIA TOURIST OFFICE
30 ROCKEFELLER PLAZA, NEW YORK, N.Y. 10112 (212) 586-4901
3550 WILSHIRE BLVD., LOS ANGELES, CA. 90010 (213) 380-8855
230 N. MICHIGAN AVE., CHICAGO, IL. 60601 (312) 236-6899
POST BOX 342 T.D. CENTRE TORONTO, CANADA (416) 362-3188
MIAMI, FLA. (305) 944-7099 DALLAS, TEXAS (214) 234-2233
SAN FRANCISCO, CA. (415) 564-2973

best shows on earth. But always, there is another open courtyard, and in every direction are those huge towers reaching up into the sky, leading the pilgrim on to the innermost shrine.

At the very entrance to that shrine, in the darkest recesses, the holiday-making atmosphere may still prevail. But there is a different quality to the sound and to the light, the aroma of incense or fresh jasmine pervades the shadows, and the stone floors feel especially cool to the pilgrim's bare feet. Most delay their entrance into the shrine by making the final *parikrama.* This last inner court, covered by a heavy stone roof, sometimes painted and always rich with carvings, is lit mainly by openings that pierce the walls at the ceiling, letting in shafts of sunlight. Today there is an occasional fluorescent light, fed by straggling wires, sputtering away as if gently mocking the futility and inadequacy of modern technology.

The pilgrim may walk around that inner courtyard several times, preparing for the ultimate experience of the pilgrimage, but there is nothing sanctimonious about this. In most cases the scene looks more like a crowd of people milling around, finding something to do until the box office opens and admits them into the movie house. And when the pilgrim emerges there is still no smugness. I saw no one who appeared to have achieved instant enlightenment, but a transformation *had* taken place. The most common manifestation was a quality of effervescence. Those with cameras immediately got their friends or some bystander to take a picture of them at the entrance, beside the sign that says "No Photography Beyond This Point." Not once did I see anyone photographed *before* going into the inner shrine.

There are, of course, many different kinds of man-made shrines other than temples. Frequently, Muslim, Hindu, Buddhist, and Jain shrines can be found huddled together, combining their diverse efforts to sanctify the same place, as at Rajgir, nestled in the hills between the ancient Buddhist university of Nalanda and the place of the Buddha's enlightenment, at Buddh Gaya. There it is impossible to be exclusive about religion, and gaudy pictures of Christian figures and saints are on sale alongside similar pictures of Indian deities. A Muslim mosque looks across to hot springs, sacred to Hindus, lying at the base of a hill sanctified by Jains and Buddhists alike.

Sometimes man glorifies himself, perhaps unconsciously, by carving gigantic images of holy people, such as the enormous sitting, standing, or recumbent figures of the Buddha and other teachers. One of these, at Sravanabelagola in a remote, hot, and dusty part of southern India, is reached by climbing a precipitous flight of six hundred steps cut into the rocky mountainside. The sixty-foot high image of a Jain epic hero, Gommateswara, is set back on the summit and cannot be seen from below: even on reaching the top, the pilgrim has to pass several other shrines and through the wall of a large courtyard before reaching the ultimate goal. There two immense feet planted in a huge lotus seem to dare the pilgrim to look upward and meet the eyes of Gommateswara. A priest at this shrine told me that some pilgrims never look up; they perform *puja* at the feet and find that is enough. "It is not everyone that wants to look up and reach that high," he said. And indeed, as pilgrims, young and old, arrived, some of them barely gave the gigantic figure as much as a glance. That was not what they had come for; they had come to worship where pilgrims had come for a thousand years. It is the power of these images—or of living saints and other sacred people—to inspire devotion in the living that draws the pilgrims; the pilgrimage is a manifestation of that devotion and is more important and perhaps even more sacred than the shrine itself.

This helps explain the attraction of so many of India's pilgrims to "holy men," some of whom are known to be charlatans, brazen tricksters, or commercial performers and who seem to be anything but holy. Like the tourist who knows that he has been taken, the pilgrim has at least had an experience he would not have had otherwise. The tourist determined to find enjoyment will find it no matter what; pilgrims who seek spiritual growth or some other kind of religious gain can win by pitting themselves against the quacks and frauds they are bound to meet on the pilgrim trail. Many a shrewd trickster, claiming to be divine, asserts that he deliberately assumes a gross form and surrounds himself with the trappings of degeneracy in order to test his disciples. It is a difficult argument to counter. Thirty years ago, the best-known of the living teachers assiduously refrained from any semblance of trickery, pretended to no miracles, and were untouched by the slightest scandal. But today the best-known gurus are highly controversial, some openly perform sleight of hand when they appear in public and even make sexual advances in private.

There is no precise counterpart in tourism to this third kind of pilgrimage, the pilgrimage to sacred people. Tourist resorts do indeed sometimes grow up around the place of the birth or death of famous people and become sites of secular pilgrimage to honor heroes. But there is nothing quite like the pilgrim's quest for contact with a living person touched with power.

The extent to which India's gurus open their homes, or ashrams, to the public varies. In the course of my research at Benares Hindu University I visited most of the best-known ashrams and, probably because of my work, was readily given access to the teachers themselves. But that is not always the case. Anandamayi, for instance, who was my teacher for two years, went to great lengths to escape the public. At a moment's notice she would make her way to the nearest train station and take off for some destination, perhaps hundreds of miles away. It took a particularly devoted pilgrim to follow that kind of trail.

Down in Mangalore, on the west coast, Swami Ramdas used to tell pilgrims who sought him out to go and climb a nearby mountain every dawn and learn from watching the sunrise. That was just about as far as I ever got with him, but at least his disciples made me welcome, and I, together with other pilgrims, was free to participate in all ashram activities (provided I had watched the sunrise from the mountaintop). In Tamil Nadu, however, the disciples of Sri Raman Maharishi kept tight control over all pilgrims seeking their master out in his retreat near the sacred mountain Arunachala. In his old age Maharishi never moved from his quarters, and even disciples seldom got inside to see him. Perhaps that is what made it possible for the great man to be so warm and easy with those who did make it through the defenses, giving them so much of his time, wisdom, and strength.

When I last saw Maharishi, he was dying of cancer, and so last year, nearly thirty years after his death, I went back to see what had happened to his ashram as a place of pilgrimage. Even the town of Tiruvannamalai, with its magnificent temple covering some twenty-five acres, had changed. Because it is still as inaccessible as ever, the number of pil-

grims has not increased much, but the quality of the experience it offers is different. For pilgrims who do not want the admittedly severe austerity of *dharmashala,* there are now hotels as well. The temple has been fitted with electric light, changing the mood of much of the interior, removing much of the mystery it held when it was lit only by flares, butter lamps, and occasional shafts of sunlight. The ashram, no longer with a saint to protect, accepts paying visitors, and a large entrance gateway, laced as it was with palm fronds, reminded me of the entrance to a tropical island holiday camp. A richly elaborate altar over the tomb of the dead teacher is set in an ornate, cold marble hall, a stark contrast to the warm, quiet simplicity of Maharishi's life.

I also visited the ashram of another great saint who had died not long after I last saw him, back in 1950. Sri Aurobindo was one of India's three most highly respected religious leaders. Before becoming a "sacred person," he had been a university professor and a political activist; as a result of his political activity, he had spent time in jail. He believed it was possible for humans to reach up and raise themselves above their present level, bringing about the rule of the Divine on earth. This was to be no easy endeavor, and Sri Aurobindo established an ashram in Pondicherry where his disciples underwent rigorous training of mind and body, as well as soul. He himself was more of a recluse than any of the other great teachers, appearing even to his disciples only once a year, for a brief *darshan,* or "audience," to which pilgrims came from all over the country. His presence was felt so powerfully throughout the ashram, however, that pilgrims actually came at all times of the year, not just for the one day of *darshan.* To be in the actual presence of the man was almost unbearable, and although I was a total skeptic at the time, when his eyes met and held mine I immediately developed a violent headache that lasted the rest of the day. I could understand why some pilgrims preferred not to come for *darshan,* just as some did not want to look up to the eyes of Gommateswara, sixty feet above them, and perhaps why some tourists even seem to hold themselves back from certain experiences, as though afraid that they might rupture the normality of the everyday world to which they must return.

I was not surprised to find that despite the death of Sri Aurobindo so



For a booklet on the history of our town and our hollow, just write us

MR. TOODLER BRANCH is the one and only landmark in Lynchburg, Tennessee, that the government doesn't know about.

Our courthouse on the town square dates back to 1885. Our jail pre-dates that. And our distillery, where smooth-sippin' whiskey has been made since Jack Daniel settled here in 1866, is registered as America's oldest. Recently, the United States Government named all these places National Historic Sites. And if they ever saw Toodler, we bet they'd name him one too.

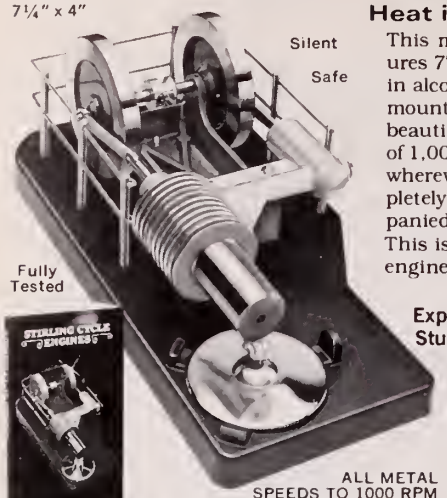


CHARCOAL MELLOWED DROP BY DROP

Tennessee Whiskey • 90 Proof • Distilled and Bottled by Jack Daniel Distillery.
Lem Motlow, Prop. Inc., Route 1, Lynchburg (Pop. 361), Tennessee 37352
Placed in the National Register of Historic Places by the United States Government

The Amazing Stirling Cycle **Hot Air Engine**

7¼" x 4"



Heat is the only fuel required!

This miniature Stirling Cycle Engine measures 7" x 4¼" and comes complete with built-in alcohol burner. Red flywheels and chassis mounted on a green base, these all-metal beauties silently running at speeds in excess of 1,000 RPM attract attention and create awe wherever displayed. The model comes completely assembled and ready to run, accompanied by our "Stirling Cycle Engines" book. This is one of a series of four model hot air engines now available.

Experimenters • Hobbyists' Power Source
Students • Collectors • Model Engineers

An easily read, lavishly illustrated, 128-page book accompanies each engine or may be purchased separately. This publication, the first of its kind, takes the reader on a 160-year tour through the world of Stirling Cycle Engines.

ALL METAL
SPEEDS TO 1000 RPM
BUILT-IN ALCOHOL BURNER

Solar Engines • 4020 E. McDOWELL RD., PHOENIX, AZ 85008 U.S.A. (602) 273-6191

NH-4 *Please send me*

_____ Engine and Book @ $53.50 . . . $_____

_____ Book (separately) @ $ 5.50 . . . $_____

Domestic Shipments Price of Engine includes shipping via United Parcel Post Price of Book includes shipping via United States Mail Book Rate There will be an additional charge for ALL 1st Class or Air Mail Shipments

TOTAL $_____

Enclosed
☐ Check ☐ Money Order
Charge My
☐ American Express ☐ VISA
☐ Master Charge

INTERBANK NO.

CARD NO.

EXPIRATION DATE

SIGNATURE

NAME (PLEASE PRINT)

ADDRESS

CITY STATE ZIP

CREDIT CARD BUYERS DIAL: (800) 528-6048

XTENDER



NOW - ENLARGE YOUR BRIDGE TABLE TO SEAT 8 PEOPLE WITH EASE!

Turn your card, or bridge table into a large, 48" diameter circular table and seat up to 8 adults with ease with our new folding portable xtender. Luxuriously topped in stain resistant vinyl, our sturdy table xtender is as attractive as it is useful. When you want to use it simply place it on top of your present table and it is held firmly in place, it won't shift. After use, lift off, FOLD AND STORE IN A CLOSET—it only takes up a few inches. Ideal for dinner or card parties, it can also be used at the beach or on picnics. Order yours today under our 21 day money back guarantee for only $39.95 plus $5 delivery. Charge to your Mastercard or Visa or send check or money order to: Columbia Mfg., Inc., 1113 East Wendover Ave., Greensboro, NC 27405.

Columbia Mfg., Inc., Dept 6S
1113 East Wendover Ave., Greensboro, NC 27405

Please send_____table xtender(s) at $39.95 plus $5 delivery for a total of $44.95. I understand that if I am not satisfied I may return it within 21 days for a full refund

☐ I am enclosing my remittance of_____or
☐ Charge $_____to my ☐ Visa ☐ Mastercard

Card# _____Exp. Date_____

Signature _____

Name _____

Address _____

City_____State_____Zip_____

FOR FASTER SERVICE CALL TOLL FREE 24 HOURS A DAY 1-800-228-2606

Susan C. Bourque and
Kay Barbara Warren

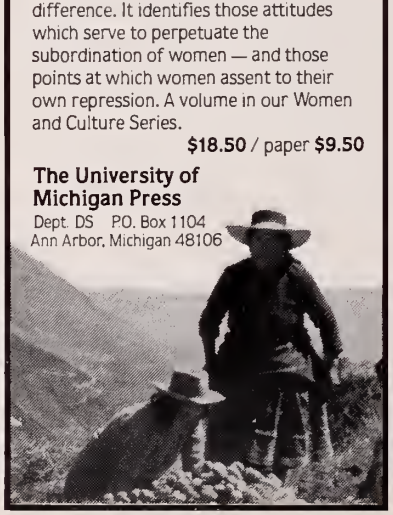
Women of the Andes

Patriarchy and Social Change in Two Peruvian Towns

The place is Peru. The characters are the women of two highland communities. The book is a study of their lives and of the cultural implications of gender difference. It identifies those attitudes which serve to perpetuate the subordination of women — and those points at which women assent to their own repression. A volume in our Women and Culture Series.

$18.50 / paper **$9.50**

The University of Michigan Press
Dept. DS P.O. Box 1104
Ann Arbor, Michigan 48106



many years ago, nothing seemed to have changed at the ashram. Visitors of all kinds are equally welcome, even the merely curious. For those not willing to accept the full discipline of the inner ashram there are separate residences, and as before, they are always occupied. The atmosphere is still like that of a holiday camp. At Sri Aurobindo ashram, peer pressure compels all to devote time and energy each day to physical exercise, either sports or calisthenics, as well as pursuing some course of academic study and dedicating some hours to group and private meditation. As with some other ashrams, many Indians (regardless of religion) come here for their vacations and speak of their one- or two-week stay as a holiday, and nothing more. The place, the atmosphere, the communal activities make them "feel good."

Although the ashram itself has not changed that much in thirty years, it stimulated a change in the local community that, at first, promised to be spectacular. In the belief that "there should be somewhere on earth a place . . . where all human beings of goodwill . . . could live freely as citizens of the world and obey one single authority, that of the supreme truth," the ashram founded a separate community, Auroville, or City of Dawn, a few miles up the coast. The concept received the enthusiastic support of UNESCO, which encouraged its member states to participate in "the development of Auroville as an international cultural township." Volunteers quickly came forward, including a European architect who drew up an ambitious plan, and a throng of untrained but dedicated youth willing to contribute their labor. In February of 1968 the foundation stone was laid. Young people came from 23 Indian states and from 121 countries. All brought a handful of soil from their home country, and placed it in a marble lotus urn in the new amphitheater, dedicating their young lives to a dream come true—a paradise on Earth. On completion the City of Dawn was to house some 50,000 international citizens, a vast human experiment in the conscious evolution of a new and better way of life.

Near the central amphitheater would tower an extraordinary shrine, the Matri Mandir, or Mother Temple. This vast golden sphere, raised up into the sky on four pillars, was to contain twelve inner and four outer gardens and a huge meditation hall, open to the sky. Work on this and other projects

was eagerly begun—and then the dream began to turn sour. A pilgrim resort, much like a tourist resort, may or may not be a blessing to the local community. Too much depends on the highly variable and fluctuating quality of the pilgrims/tourists themselves, on what they import with them and what they leave behind. Unfortunately, Auroville quickly attracted some of the youthful flotsam of America and Europe, young people who felt that the world owed them a life of nothing but ease and pleasure. They also had an ideal of sorts, but it was far different from that of the founders of Auroville. Instead of a life of discipline, dedication, and service, they wanted nothing more than to live under the palm trees on the beaches, free to indulge in the latest fashions in sex and drugs. Drug smuggling brought in the police, the excess of freedom brought anarchy, and many of the dedicated Aurovillans simply left to pursue their dream elsewhere. All construction work stopped, and by last year, the amphitheater was overgrown with weeds and inhabited only by snakes and lizards. The farmland was a desert; the roads all but impassable. The great Matri Mandir rears its framework up into the sky, an ugly skeleton of unfinished concrete and rusting steel. The population has shrunk to a bare handful, rent by dissension and charges of racism, bigotry, profiteering, and immorality. Auroville stands as a monument to the emptiness of a dream in which discipline and total dedication had no part.

While both pilgrimage and tourism involve hard realities for communities that become resort centers, they have more than this in common. They both stimulate dreams that, however unmatched by reality, have the ability to enrich and enlighten, giving the dreamer fresh hope and fresh life. Unlike reality, dreams do no harm to others, and more often than not, they do incalculable good in terms of both social and spiritual consciousness. There is no question as to the social benefits of pilgrimage in India, and insofar as dreams are the stuff that tourism, at its best, is made of, we have to admit of at least the potential of spiritual benefit from tourism. India shows us just how closely tourism and pilgrimage are connected.

Colin Turnbull, formerly associate curator of African ethnology at the American Museum of Natural History, is visiting professor of anthropology at George Washington University.

DISCOVERY TOUR TO THE NILE



American Museum of Natural History
Discovery Tours

Discover the world of ancient and modern Egypt on an American Museum 600 mile Nile Cruise. Explore with three lecturers the rich natural and archeological sites of an area which has fascinated visitors for centuries... A carefully planned itinerary (with a special two-day program in London visiting the British Museum with its keeper) provides a relaxing and thorough three-week Discovery Tour. All of the major Nile archeological sites as well as the important wildlife regions are discussed and visited with your balanced team of eminent lecturers. Share with Museum staff and friends an unforgettable cruise. February 9-25, 1982. For further information and itineraries write to the **American Museum of Natural History, Discovery Tours,** Central Park West at 79 St., NY NY 10024, or call (212) 873-1440.



Chinese delicacy.

Exquisite cinnabar egg makes an extraordinary accent piece or special gift. Careful layering of Chinese cinnabar lacquer, accentuated by delicate Oriental carvings, conveys a most exotic quality. Includes rosewood stand. 4" high. Your satisfaction guaranteed, underwritten through our Lloyd's of London correspondents. Just $33.50 (including postage), from Willoughby & Taylor Ltd., 4R0150, 2912 Iron Ridge Road, Dallas, Texas 75247. Cheque, money order or all major charge cards.

☐ YES! Please send me complete catalogue of international treasures, free with my order. ($1.00 separately.)

Willoughby & Taylor Ltd.
International Merchants

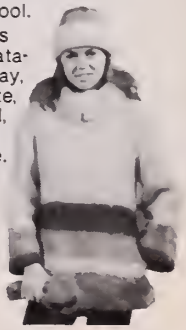
Call Toll-free (800) 323-1718 for charge orders. In Illinois (800) 942-8881. Ask for Operator 102.

CHOOSE FROM THE WORLD'S LARGEST SELECTION OF...

IMPORTED ICELANDIC WOOLENS

Landau offers the world's largest selection of imported Icelandic woolens for men, women & children. Jackets, ponchos, coats, hand-knit sweaters, mittens, scarves, blankets and more. All 100% Icelandic wool. The world's lightest, warmest wool.

Send $2 for a series of three full-color catalogs...Winter/Holiday, Spring and Fall. Write, or Visa, MasterCard, American Express holders call toll free.



To Order A Series Of 3 Catalogs For $2... Call Toll Free 800-257-9445 (N.J. Residents 800-792-8333)

Or write
LANDAU Dept. NH-09
P.O. Box 671
114 Nassau Street
Princeton, NJ 08540

LANDAU PRINCETON N.J.

Visit Our Shops In Princeton, NJ/ Manchester, VT.

Come explore a comet.

Halley's Comet returns in 1985. The Europeans, the Soviets, and the Japanese are readying spacecraft to meet it. Our nation plans to watch from afar because NASA has no money for a Halley mission even though only the U. S. has the technology needed to fully probe this comet for the clues it offers on

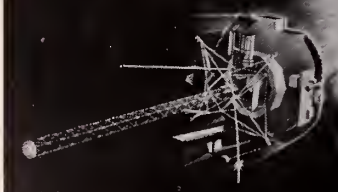


the origin of our solar system. We stand to lose not only knowledge, but also new technologies and a bit of our prestige.

Last year 10,000 people used the Viking Fund to show their support for space exploration. They contributed an average of $10 apiece to help one starving project: the Viking lander on Mars.

Now the Viking Fund's organizers announce the Halley Fund. By donating to this new fund, you'll let Washington know you want a U.S. probe of this comet. Your money will help pay for the mission, for Halley studies from the shuttle, and for U. S. participation in the International Halley Watch.

So come explore a comet, but don't delay. Your next chance to contribute to a Halley fund won't come until the year 2062.



THE HALLEY FUND

Dept. NH
3033 Moorpark Avenue, Suite 27
San Jose, CA 95128

I want to help pay the cost of U.S. studies of Halley's Comet.

Name

Address

City State Zip

(Donations tax deductible)

Celestial Events

by Thomas D. Nicholson

The Moon The very early crescent moon highlights the gathering of Venus, Jupiter, Saturn, and the star Spica in the western sky on September 1 and 2. The late crescent moon passes very close to Mars during the morning of September 24, covering the planet (an occultation) over parts of the Southern Hemisphere. Phases are: first-quarter on September 6, full on the 13th, last-quarter on the 20th, and new on the 27th. First-quarter occurs again on October 6 and full moon on the 13th. Apogee (farthest from the earth) is on September 5 and October 2 and 30; perigee (nearest the earth) is on September 16 and October 14. The full moon on September 13 is the harvest moon, that on October 13 is the hunter's moon. On both occasions, the full or nearly full moon rises only about half an hour later each night for several days in a row, as compared with the average delay of about fifty minutes.

Stars and Planets Early in August, Venus is near Jupiter and Saturn, all in the west during twilight. Venus, the brightest, appears about half an hour after sunset, then Jupiter appears, and finally Saturn, to Jupiter's right. By then you can also see Spica, in Virgo, to the left and above Venus and about as bright as Saturn. All of them set at about the end of twilight. After the first of the month, Venus creeps slowly toward Spica, passing above it on the 6th, then moving away, meantime separating from Jupiter and Saturn as they set earlier each night until, by midmonth at the latest, they are too low to be visible in the twilight. Venus continues to set at about the same time, relative to sunset. In the morning, Mars becomes more favorably placed, rising about four hours before the sun. But it still isn't much brighter than a second-magnitude star, such as Polaris, the North Star. It will begin to brighten dramatically in November, and should be a fairly prominent object this coming winter. On September 15, the sun moves from the constellation Leo into Virgo, joining the five planets already in Virgo—Mercury, Jupiter, Saturn, and Pluto, there all month, and Venus, there until the 19th. Uranus, in Libra, and Neptune, in Ophiuchus, are not far from Virgo's



eastern border. All of these planets are east of the sun, which makes them evening stars. Even Mars, in Cancer, the one vagrant in the morning sky, is only about 50 degrees from Virgo's western border.

In mid-September, the sun joins five planets (Mercury, Venus, Jupiter, Saturn, and Pluto) in Virgo, with Uranus and Neptune nearby in Libra and Ophiuchus. All are evening stars. Even Mars, the one wanderer in the morning sky, is not far to the sun's right. Is this an unusual planetary alignment? Yes, but it is of significance only to skywatchers. Rumors about an impending alignment of planets in 1982 are puzzling to astronomers. No close "lineup" will occur, and even if one did, it would go unnoticed unless it were called to your attention.



Helmut Wimmer

YOU CAN TAKE IT WITH YOU



C5 Telescope

Tiger —
750mm f/6 photo





C8 Telescope with
35mm camera attached

35mm photography
is as easy as adding
your camera for exciting
close-ups of your favorite subjects.

CELESTRON telescopes and telephoto lenses are compact and lightweight. The modern Celestron design means you can take it anywhere and have it set up and operating in minutes. Under clear, dark, steady skies, the amount of detail seen through Celestron telescopes borders on the fabulous. As a daytime telescope, see or photograph ships, planes, wildlife and people at incredible distances with complete clarity. Apertures available from 3-1/2" to 14" priced from $295.00. Celestron also has a full line of binoculars of astronomical quality.



C8 one-hand
portability

Send $2.00 for 32-page full color
catalog on how to select and use
a Celestron telescope or telephoto lens.

(DEALER INQUIRIES INVITED)

Celestron

CELESTRON INTERNATIONAL, 2835 Columbia St., Box 3578-NH Torrance, CA 90503, U.S.A.
(213) 328-9560

¡Speak Spanish like a diplomat!

What sort of people need to learn a foreign language as quickly and effectively as possible? *Foreign Service personnel*, that's who. Members of America's diplomatic corps are assigned to U.S. embassies abroad, where they must be able to converse fluently in every situation.

Now *you* can learn to speak Spanish just as these diplomatic personnel do—with the Foreign Service Institute's Programmatic Spanish Course.

The U.S. Department of State has spent tens of thousands of dollars developing this course. It's by far the most effective way to learn Spanish at your own convenience and at your own pace.

The Programmatic Spanish Course consists of a series of tape cassettes and an accompanying textbook. You simply follow the spoken and written instructions, listening and repeating. By the end of the course, you'll find yourself learning and speaking entirely in Spanish!

This course turns your cassette player into a "teaching machine." With its unique "programmatic" learning method, you set your own pace—testing yourself, correcting errors, reinforcing accurate responses.

The FSI's Programmatic Spanish Course comes in two volumes. You may order one or both courses:

☐ Volume I, Basic.
(12 cassettes, 17 hours), instructor's manual and 464-page text, $115

☐ Volume II, Intermediate.
(8 cassettes, 11½ hours), instructor's manual and 614 page text, $98

(New York residents add sales tax.)

Your cassettes are shipped to you in handsome library binders.

TO ORDER, JUST CLIP THIS AD and mail with your name and address, and a check or money order. Or, charge to your credit card (American Express, VISA, Master Charge, Diners Club) by enclosing card number, expiration date, and your signature.

The Foreign Service Institute's Spanish course is unconditionally guaranteed. Try it for three weeks. If you're not convinced it's the fastest, easiest, most painless way to learn Spanish, return it and we'll refund every penny you paid! Order today!

Many other FSI language courses also available. Write us.



Audio-Forum
Dept. L-24
145 East 49th St.
New York, N.Y. 10017
(212)753-1783

AUDIO-FORUM

OLD PUEBLO TRADERS since 1946



send $1 today for a FALL CATALOG PLUS...$2 BONUS DISCOUNT to use on your first order

if you want...
famous labels
- top quality
- comfortable fit

many in hard to find sizes:
- missy • half
- large • petite

shoes & accessories...
- wide selection of styles and sizes

SEND COUPON TODAY—MONEY BACK GUARANTEE

OLD PUEBLO TRADERS, Dept. NH9,
Box 27800, Palo Verde at 33rd, Tucson, AZ 85726

☐ Enclosed is $ _____ (check or money order)

NAME _____
(please print)
ADDRESS _____

CITY _____ ST _____ ZIP _____



Treasures From The Earth

Color Portfolio of Natural Specimens and Catalog of Minerals, Display Stands, Books and Natural Jewelry, $3.00

Dover Scientific
Box 6011C Long Island City, NY 11106

Nature & Cultural Expeditions



Combine adventure, discovery, learning and vacation on nature, cultural and photography expeditions worldwide!

Join small groups interested in Baja California . . . Alaska . . . Galapagos . . . Japan . . . Bhutan . . . China . . . Nepal . . . Polynesia . . . Tanzania . . . Scotland . . . and more than 25 other unique areas worldwide led by experts in anthropology, natural history or photography.

For complimentary brochures and itineraries write

Nature Expeditions International
599 College Ave. • Dept. N • Palo Alto, CA 94306 • (415)494-6572

August 31–September 2: The moon passes Saturn, Jupiter, and Venus during the night on Monday, moves between Venus and Spica on Tuesday night, and then moves away from Spica on Wednesday. The three planets and the star will all set within two hours of sundown.

September 5: Look below the crescent moon tonight for the reddish star Antares, in Scorpius.

September 6: Venus moves from right to left past Spica.

September 7: The "teacup" arrangement of eight stars below the gibbous moon identifies the constellation Sagittarius.

September 13: Tonight's full moon is the harvest moon. It seems to illuminate the early nighttime for several nights in a row, making it particularly useful to farmers staying up late to finish the late summer harvest.

September 19: The waning gibbous moon rises after 10:00 P.M. in Taurus, about midway between the Pleiades ("Seven Sisters") and the reddish star Aldebaran, in the V-shaped Hyades.

September 22: The sun arrives at the autumnal equinox, a point in the constellation Virgo, at 10:05 P.M., EST, and autumn begins officially in the Northern Hemisphere.

September 23: Mercury is at greatest easterly elongation, ordinarily placing it in the best position to be seen as an evening star. But this is an unfavorable elongation. The planet is too low at sunset to be seen.

September 23–24: The moon rises about two hours after midnight (standard time), with the planet Mars below the crescent.

September 26: Although the autumnal equinox occurred on the 22nd, this is the day when the sun spends twelve hours above the horizon and twelve hours below.

September 29: The early crescent moon is in conjunction with Mercury, but the planet is too far south of the moon and sets too early to be seen.

October 1: Venus is easily located below the crescent moon tonight.

October 5: Saturn is in conjunction with the sun and becomes a morning star.

October 6: Mercury becomes stationary among the stars and begins moving westerly (retrograde).

October 13: Tonight's full moon is the hunter's moon.

October 14: Jupiter is in conjunction with the sun and enters the morning sky.

AMERICAN MUSEUM OF NATURAL HISTORY
Vacations on sea and land with Museum Lecturers



INDONESIAN ODYSSEY: Cruise through the paradise islands of Bali, Java, Komodo, Sulawesi, Lombok, Flores, Butung, the Moluccas and Luciparas aboard the luxury vessel, *Regina Maris*. Share with a Museum astronomer, anthropologist, ornithologist, geologist/volcanologist, and herpetologist a unique, in-depth travel experience. The itinerary takes you to lush tropical landscapes with exotic peoples influenced for centuries by India, Islam and Europe.

NILE CRUISE: Explore the astounding ancient sites and natural wonders of Egypt with a Museum geologist, ornithologist/illustrator, and Egyptologist. Cruise 600 miles on the Nile from Cairo to Assuan aboard the custom-built, air-conditioned *Nile Star* stopping at all the important sites which have intrigued visitors since their construction.

GALAPAGOS ISLANDS CRUISE: Discover a special natural world with fantastically tame and exotic animals such as sea lions, giant tortoises, marine and land iguanas and countless rare and beautiful birds. Enjoy the expertise of a Museum ornithologist and herpetologist and four local naturalists as we cruise through this equatorial archipelago which so influenced Darwin.

ADRIATIC AND AEGEAN ADVENTURE: Relive the great historical travels of the Greeks, Romans, Phoenicians and Venetians. Follow their paths on a classical cruise starting in Venice and going to Dubrovnik, Corfu, Corinth, Crete, Rhodes, Tunis, Carthage, Malta, Sicily, Pompeii, Herculaneum and Naples. The *Orpheus* will be your home for 14 beautiful days; the Museum faculty will be outstanding.

LAND PROGRAMS: Seven outstanding overland itineraries have been custom-designed for small groups of 15-25 participants. Famous and remote sites and cultures are discovered while staying at the finest accommodations available with expert Museum Lecturers.

DESTINATION	1982 Dates
☐ Indonesian Odyssey	February 21 to March 13
☐ Nile Cruise	February 8 to 28
☐ Galapagos Islands Cruise	June 9 to 21
☐ Adriatic and Aegean Adventure	September 1 to 16
☐ Archeology Tour to Mexico	January 11 to 29
☐ Ancient Maya Archeology	February 1 to 18
☐ East African Safari	February 3 to 21
☐ Art and Archeology Tour to China	March (exact dates not available)
☐ Anthropology Tour to Morocco	April 4 to 17
☐ Alaskan Wildlife Adventure	June (exact dates not available)
☐ Art and Archeology Tour to China	Fall (exact dates not available)
☐ 1982 General Program	

Please send me information regarding the itineraries of the tours I have checked.

Name _____ (Please print)

Address _____

City _____ State _____ Zip _____

American Museum of Natural History

Discovery Tours

Central Park West at 79th Street New York, N Y. 10024

THE MARKET

Art

AMERICAN INDIAN CRAFTS: Pueblo pottery; Hopi 2nd and 3rd Mesa plaques; Kachinas; old and new rugs. No catalogue. One-of-a-kind pieces; individually photographed. Most priced $100/up. Write for photos and data, specifying interests. Box 5896, Sherman Oaks, CA 91413 (213) 789-2559



Pre-Columbian Rubbings of Ancient Temple Ruins

DIVING GOD (Mayan 564 A.D.) at Tulum, the walled-city of the Yucatan overlooking the Caribbean—only one of many splendid rubbings! Complete catalog $2 (deductible with order)

BERNARDO
2400 Westheimer 108W (NH9)
Houston, TX 77098

BRITISH BRASS RUBBINGS. Portraits of the nobility and gentry of the past. Rubbings of monumental church brasses. Individually handmade by British craftsmen. A unique decorator item. An unusual gift. Catalogue $1. Godolphin, 6910 E. Mesa Grande Drive, Tucson, AZ 85715

FREE! COLOR BROCHURE, Large National Park Prints by M. Woodbridge Williams, Photo Classics, Dickerson, Maryland 20753

GURULU MASK, Sri Lanka, 10", painted wood, $28, request photo, McCoy Imports, Liberty, NY 12754

STAINED GLASS. Your favorite flora and fauna in exclusive editions. Beautiful hardwood frames. Photos: Proust and Cline. Rt. 1, Box 419, Trinidad, CA 95570

WHALES of hand-carved pine. Illustrated brochure $1.00. Doug Lind, P.O. Box 74, Burlington, WI 53105

Book Publishers

PUBLISH YOUR BOOK! Join our successful authors. Publicity, advertising, beautiful books. All subjects invited. Send for fact-filled booklet and free manuscript report. Carlton Press, Dept. NHI, 84 Fifth Avenue, New York 10011

Books

BOOKFINDING. Librarians search worldwide titles or subjects plus 150,000 indexed stock. PAB, 2918 Atlantic, Atlantic City, NJ 08401 (609) 344-1943

PUBLISHERS' OVERSTOCKS, BARGAIN BOOKS. 2,000 titles, all subjects! Free catalogue: Hamilton's, 98 55 Clapboard, Danbury, CT 06810

YESTERDAY'S BOOKS LOCATED, no obligation. Out-of-State Book Service, Box 3253J, San Clemente, CA 92672 (714) 492-2976

Collectors' Items

BASEBALL CARDS WANTED—Check your attic! Buying baseball cards 1976 and before. $2.00 for illustrated buying price list. Baseball Cards, P.O. Box 974, Groton, MA 01450

BIRDS, ANIMALS OR FLOWERS on postage stamps from many countries. 25 different 35¢. George Ford, P.O. Box 5203-N, Gulfport, FL 33737

RECEIVE VALUABLE MINERALS MONTHLY! Free Details! Write today! Mineral of the Month Club, 13057-H25 California, Yucaipa, CA 92399

Correspondence

MAKE FRIENDS WORLDWIDE through international correspondence. Illustrated brochure free! Hermes-Verlag, Box 110660/NH, D-1000 Berlin 11, West Germany

ORIENTAL WOMEN SEEK CORRESPONDENCE for cultural exchange, language practice, friendship. Asian Exchange, Honokaa, Hawaii 96727

PENFRIENDS-ENGLAND-USA. Make lasting friendships through correspondence. Send age, interests. Free reply. Harmony, Box 89NH, Brooklyn, NY 11235

Education

EXPLORE MICROSCOPIC WORLD—algae, protozoans, blood cells, etc. New Science Course for all ages. How to purchase and use a microscope with free brochure. Life Sciences, Box 591B, Woodbury, NJ 08096

PARENT GUIDE TO RESOURCES FOR THE GIFTED. Unique tools to turn on thinking: games, books, and practical information for developing the potential of bright youngsters. Send $2 to Resources, 3421 N. 44th St., Phoenix, AZ 85018

THINGS of Science—fun activities in science for young, inquiring minds, 10 to 16. A kit is mailed each month with background, materials, and easy to follow instructions for many demonstrations and experiments. Membership—$17.50 per year. Gift card sent if requested. THINGS of Science, RD 1, Box 130NA, Newtown, PA 18940

Employment Opportunities

AUSTRALIA NEEDS YOU! Jobs! Paid Transportation! Newest handbook, $2.00 (guaranteed). Australian International Services, Box 19107-RW, Washington, DC 20036

OVERSEAS—ALL OCCUPATIONS! Worldwide Directory and complete information—$3.00. International Opportunities, Box 19107 RW, Washington, DC 20036

ROCKY MOUNTAIN EMPLOYMENT NEWSLETTER! Colorado, Idaho, Montana, Wyoming! Current openings—all occupations! Free details . . . Intermountain 4Y, 3506 Birch, Cheyenne, WY 82001

Financial

GET CASH GRANTS—from Government. (Never repay.) Also, cash loans available. All ages eligible. Complete information, $2 (refundable). Surplus Funds-NH, 1629 K St., Washington, D.C. 20006

Foreign Newspapers

WORLDWIDE ENGLISH NEWSPAPERS. 65 countries including Germany! Sampler: 5/$2.98. Free Brochure. Multinewspapers, Box DE-206, Dana Point, CA 92629

Gourmet Interests

ALL NATURAL BREAD easy recipe, whole wheat and yeast. Nutritious. Also Quick Easy Elegant main course and dessert. $2.50 Sofie, P.O. Box 2001, New Canaan, CT 06840

FANTASTIC SOUPS! Palate pleasing. Home Kitchen Tested. 5 gourmet Easy recipes. Hot and cold. $2.00 SASE CC, 10113 Joershke Dr., Suite 193, Grass Valley, CA 95945

OLD FRONTIER RECIPES. Easy. Delicious. $1.00 each SASE. State preference. Old Recipes. P.O. Box 4407, Omaha, NB 68104

OLD OUEBEC STYLE Chili Con Carne. Send $2 SASE to Box 194, Mountlake Terrace, WA 98043

Government Surplus

"GOVERNMENT SURPLUS DIRECTORY." Buy 500,000 items (including Jeeps) . . . low as 2¢ on dollar! Most complete information available-$2.00. Disposal, Box 19107-RW, Washington, DC 20036

JEEPS—$58.00!—CARS—$35.00!—700,000 Items! Government Surplus—Most Comprehensive Directory Available Tells How, Where To Buy—Your Area—$2—Moneyback Guarantee—"Surplus Information Services", Box 99249-DC9, San Francisco, California 94109

Merchandise

BRIDGECLOTH SETS 54" square with 6 napkins. White with hand appliqued flowers. Specify green, yellow, pink, blue. $39.95 ppd. Money Back Guarantee. Check, Visa, Mastercharge. CC, 10113 Joerschke Dr., Suite # 193, Grass Valley, CA 95945

FREE CATALOGUE—Peoplefeeders and birdfeeders. Wildlife prints, Austrian backscrubbers, Norwegian footwear dryers, more. Quality merchandise, gifts and decor items. Fresh ideas from The Armchair Emporium Ltd., 825 Surrey Ln., Dept. NH, Algonquin, IL 60102

NEW CO. offers Full color serigraph designs on fabric. Wall prints & T-shirts. Mexican dance masks, Orchids & Wild life. Free Brochure Emil Enterprise, P.O. Box 1532, San Luis Obispo, CA 93401

PURCHASE Bowie, Civil War knives, Indian tomahawks. Robert Abels, 2881 N.E. 33 Court, Fort Lauderdale, FL 33306

Miscellaneous

GENEALOGY—Learn to trace your own roots. All the information you need plus 15 generation family tree chart, $4.50. Genealogy, P.O. Box 974, Groton, MA 01450

Music

MODERN PIANO—Harmony theory. Jazz improvization. Former staff pianist ABC-TV Special adult course. NYC Tel: (212) 879-1153

RECORD-TAPES! Discounts to 73%. All labels; no purchase obligations; newsletter, discount dividend certificates. 100% guarantees. Free details. Discount Music Club, 650 Main Street, P.O. Box 2000, Dept. 25-0981, New Rochelle, NY 10801

OLD TIME RADIO PROGRAMS on cassette tapes. Free catalogue. Cassette Library Center, P.O. Box 5331H, Baltimore, MD 21209

Optical

BINOCULAR SALES AND SERVICE. Repairing binoculars since 1923. Alignment performed on our U.S. Navy collimator. Free catalogue and our article "Know Your Binoculars," published in Audubon Magazine. Mirakel Optical Co., Inc., 331 Mansion St., West Coxsackie, NY 12192 (518) 731-2610

LEITZ, ZEISS, B&L, SWIFT, BUSHNELL, NIKON. Optolyth binoculars, telescopes and accessories. Send stamp for discount list. Specify literature desired. Large stock. Orders filled postpaid day received. Birding, Box 5N, Amsterdam, NY 12010

OPTIC DISCOUNTS. Binoculars—Telescopes—Brand Names—Free List. Thos. Manetta, Box 12, 61 Hoffman Avenue, Elmont, NY 11003

STARTING SEPT. 12, Workshop—New York Microscopical Society, "How To Use A Microscope". Registrar, Margaret Cubberly, Columbia Medical Center, 630 W. 168th Street, New York, NY 10032

Photography

THE FLYING EAGLE®. Finest laser color reproductions of the ultimate Bald Eagle photograph. 16 x 20 Fine Art Print, $20. Kenneth R. Hunter, Ph.D., Egegik, Alaska 99579

Real Estate

FREE! Big Fall-Holiday Catalogue! Over 5,400 country properties described, pictured! Land, Farms, Homes, Businesses, Waterfront, Recreation, Retirement buys! Selected best thruout the U.S. Over 700 offices, 43 states. All Across America! Yours Free from the World's Largest! Strout Realty, Inc., 60 E. 42nd Street, Dept. 5390, New York, NY 10017

FREE . . 296-PAGE CATALOGUE. Describes and pictures over 2,800 farms, ranches, acreages, businesses and town and country homes from coast to coast. United Farm Agency, Inc., 612-V W. 47th St. Kansas City, MO 64112. Ph. Toll-Free: 1-800-821-2599; MO. Res. Ph. Toll-Free: 1-800-892-5785

GOVERNMENT LANDS. FROM $7.50/ACRE! Homesites, farming, vacationing, investment! "Land Buyer's Guide" plus nationwide listings—$2.00. Lands, Box 19107-RW, Washington, DC 20036

Resorts

NEW MEXICO. Guided tours—wildflowers, birds, prehistoric dwellings. Bear Mountain Ranch, Silver City, NM 88061 (505) 538-2538

VACATION/RELAXATION—Birdwatcher's delight—Peaceful, secluded nature lover's mountain retreat. Cave Creek Ranch, Portal, Arizona 85632

LITTLE ST. SIMONS ISLAND

One of Georgia's "Golden Isles"



Birding, beachcombing, riding, wildlife photography, fishing or just relaxing on a secluded 12,000 acre island with miles of unspoiled ocean beaches, forests and marshes. Over 200 species of birds. Maximum of 10-15 guests at a time. Excellent food and accommodations. Professional naturalists on the staff. **Little St. Simons Island** P.O. Box 1096N, St. Simons Island, GA 31522

Tours/Trips

ADVENTURES—Photograph polar bears in the Arctic during October, touch a Whale in the breeding lagoons during February, sail among Humpback whales in Hawaii. Trips specializing in natural history with expert leaders to Tanzania, Kenya, Botswana, Rwanda and Zaire. Also Australia, Nepal, Sri Lanka, Ecuador and more. Unique expeditions to see endangered species—mountain gorillas, blue whales, Indian rhino and rare birds. New 1981-1982 trip preview available. Adventures International, 4421-N Albert St., Oakland, CA 94619

ALASKAN WATER ADVENTURES. Kayaking, Rafting, Birding in Prince William Sound and Copper River Basin. Open Door, Box 1185N, Cordova, Alaska 99574 (907) 424-7466

AMAZONAS ADVENTURES: Explorer's Inn (Peru). Amazon Lodge (Brazil). Orellana (Ecuador). Chapare (Bolivia). Day/overnight jungle expeditions/cruises. Combinable with 155 other South America programs. Forum International, 2437 Durant, Berkeley, CA 94704 (415) 843-8294

BIRD NEW MEXICO, 7 days, October, $450. Sight the Whooping Crane? Species list available. Blue Sky Adventures, Dept. NH7, Oak Ridge, NJ 07438 (201) 697-7233

DISCOVER BAJA! Join professional naturalists & crew for ocean going exploration of Baja's wilderness islands and lagoons. Gray whales up close, elephant seals, superb birding & lots more! Excellent photo opportunities, small groups. Color brochure. Pacific Adventures Charter Service, 2445 Morena Blvd., Suite 200H, San Diego, CA 92110

ENJOY NEW YORK CITY AS HOUSEGUEST. Bed & Breakfast, $30/35 S - $45/60 D. Contact The B & B Group, New Yorkers at Home, 301 E. 60 St., NY, NY 10022 (212) 838-7015

FASCINATING NATURE/LEGENDARY CULTURES: Usual and unusual travel programs to Latin America, Africa, Mideast. Forum International, 2437 Durant, Berkeley, CA 94704

5,000 YEARS PERUVIAN TEXTILE ART: visit museums, markets, weavers, and archaeological sites. Skilled leadership and weaving instruction. Forum International, 2437 Durant, Berkeley, CA 94704 (415) 843-8294

GALAPAGOS HIKING AND SAILING EXPEDITIONS. Small groups. 1982 dates: February 4, April 22, July 7, August 4. Charters. Machu Picchu options and Chili ski options. Inca Floats. 5982N Balboa, Oakland, CA 94611 (415) 339-9095

HIMALAYAN TRAVEL, INC. Trekking expeditions in the Everest and Annapurna areas of Nepal. Exotic cultures/spectacular mountain scenery. Box 481-NH, Greenwich, CT 06830 Toll Free (800) 243-5330

JERSEY PINE BARRENS—Naturalist guided canoe and backpack adventures. Pineland Voyageurs, Dept. N2, Box 453, Willingboro, NJ 08046

NEW ZEALAND WALKABOUT: A selection of escorted nature and hiking tours, featuring New Zealand's scenic National Parks, the Milford Track, Farm Holiday Stay. Pacific Exploration Company, Box 3042-N, Santa Barbara, California 93105

SAILING SCHOOL-SEASON 1981-1982. Seamanship and Navigation courses aboard 50' ketch 'Palisander'-Chesapeake Bay and Caribbean, also Blue Water Passages between. Cuttyhunk Marine Adventures, Gwynn, VA 23066

SAVE 50% ON CRUISES. Our members do. You can too. Details free. TravLtips Association, Box 188B5, Flushing, NY 11358

TRINIDAD AND TOBAGO: November 30-December 14. Join special 2-week trip sponsored by Princeton's Stony Brook-Millstone Watersheds Assn. for introduction to the Neotropics. Plants, ecology with emphasis on birds. Experienced guides, small group. Accomodations: Asa Wright Nature Centre & Arnos Vale Hotel. Time to relax, swim. Princeton Nature Tours: 282 Western Way, Princeton, NJ 08540 (609) 924-5258

RATE AND STYLE INFORMATION

$1.75 per word; 16 word ($28) minimum. *Display classified* is $150 per inch. All advertisements must be prepaid. Rates are not structured for agency or frequency discounts. All advertisements are accepted at NATURAL HISTORY's discretion. Send check/money order payable to NATURAL HISTORY Magazine, Central Park West at 79th St., New York, NY 10024. Please include your personal address and telephone number, issue preferred, and suggested heading. Deadline—8t of month, two months prior to cover date (the January issue closes Nov. 8). Camera-ready art is required for display ads. A tearsheet or copy of the page with your ad will be sent upon publication.

Free!

Edmund Scientific Catalog



OUR 40th YEAR!

Astronomy, Microscopy, Biofeedback, Weather, Alternate Energy, Binoculars, Optics, Magnets, Magnifiers, Tools, Unique Lighting, Lab Equipment, and much more. Over 4,000 unique and fascinating products. Send for our **FREE** 112-page, colorful 1981 Edmund Scientific Catalog...Today!

Rush me your free catalog!

Name

Address

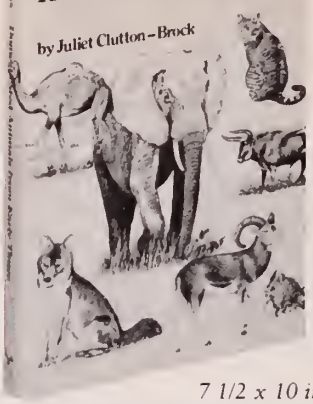
City

State Zip

Clip And Mail Coupon Today To:
Edmund Scientific Co., Dept. 8210 E-18
Edscorp Bldg., Barrington, N.J. 08007

Domesticated Animals from Early Times

by Juliet Clutton-Brock



7 1/2 x 10 in., 201 pp., 112 line drawings, 47 b&w and 25 color photos, $24.95

This comprehensive study of animal domestication provides a new and intriguing look at animals, from the household cats and dogs we are accustomed to living with to the exotic yak and vicuna.

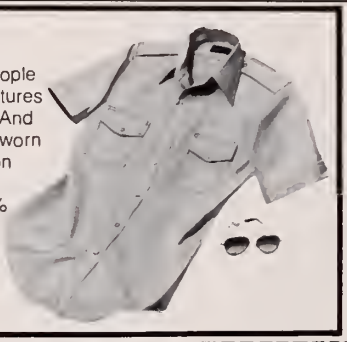
At booksellers

University of Texas Press
Box 7819 Austin, Texas 78712

The Aviator Shirt.

Authentic. Manufactured by Van Heusen—the people who supply most of America's leading airlines. Features button-through flap pockets, one with pencil slot. And epaulets, naturally. Collar looks neat and correct worn open or with tie. Extra-long tail. This special edition Van Heusen shirt is cut for comfortable fit, and smartly tailored of military-weight poplin. The 65% Dacron® polyester/35% combed cotton fabric delivers the comfort you want plus the permanent press convenience you demand. Choose khaki, blue or white. Short sleeves $16. Long sleeves $17.

® DuPont registered trademark



Size Chart for the Aviator Shirt

Neck Size	14½	15, 15½, 16, 16½, 17	17½
Sleeve Length	Med (32/33)	Med (32/33) or Long (34/35)	Long (34/35)

When ordering, indicate sleeve length by using letters M or L

Neck sizes for short sleeve shirts: 14½ to 17½

LONG SLEEVE @ $17

Qty	Color	Neck Size	Sleeve Length M or L
	White (19-567Y)		
	Blue (19-568Y)		
	Khaki (19-569Y)		

SHORT SLEEVE @ $16

Qty	Color	Neck Size
	White (19-560Y)	
	Blue (19-561Y)	
	Khaki (19-562Y)	

Add $2 per order for shipping and handling, plus local taxes where applicable
Make checks payable to Baker Street Shirtmakers
Mail your order...or call toll free (800) 528-6050

Personal Check or Money Order Visa American Express Master Charge

Card # Exp Month Year

Mr. Mrs. Ms.

Address

City State Zip

Baker Street® Shirtmakers
Creators of classic shirts at affordable prices
281 Centennial Avenue, Piscataway, New Jersey 08854

AYJ

Red Colobus (p. 36)

The Red Colobus Monkey, by T.T. Struhsaker (Chicago: University of Chicago Press, 1975), is a detailed account of this primate's social behavior and structure. Struhsaker spent twenty-seven months in Kibale Forest in western Uganda, studying colobus intragroup and intergroup social interactions, population structures and densities, food habits, and ranging and activity patterns. Although he focuses primarily on one group of *Colobus badius tephrosceles*, he also provides data on other groups and subspecies, including *C.b. temminckii*. This volume, part of the "Wildlife Behavior and Ecology" series, edited by G.B. Schaller, also has sections devoted to vocalizations and ecology and a bibliography. A more general work is T. Rowell's *Social Behaviour of Monkeys* (London: Penguin Books, 1972), which explores social organization, field and captive environments, intergroup communications, and concepts of hierarchy, territory, and roles. Drawing from her own work with wild baboons, Rowell also gives a general account of other monkeys, emphasizing the African Old World species. Much information is given on colobus, vervets, and patas monkeys. In *The Langurs of Abu* (Cambridge: Harvard University Press, 1977), S. Blaffer Hrdy studies female and male reproductive strategies in another member of the subfamily Colobinae. Her book covers encounters between troops, invasion strategies, competition among females, infant sharing, infanticidal males, and female counterstrategies. It also discusses other colobines. The twenty-eight articles in *Primate Ecology*, edited by R.W. Sussman (New York: John Wiley and Sons, 1979), represent some of the earliest attempts at problem-oriented field research. The section on Old World monkeys includes an article by T. Struhsaker and J.F. Oates, "Comparison of the Behav-

ior and Ecology of Red Colobus and Black-and-White Monkeys in Uganda: A Summary" (pp. 165–209), and "Primate Social Organization and Ecology," by T. H. Clutton-Brock (pp. 503–12). A profusely illustrated, nontechnical summary of the primates, G.H. Bourne's *Primate Odyssey* (New York: G.P. Putnam's Sons, 1974) contains sections on the Old World monkeys, including the colobus. More technical is *Old World Monkeys*, edited by J.R. Napier and P.H. Napier (New York: Academic Press, 1970), a collection of nineteen articles on the anatomy, evolution, ecology, behavior, ethology, and taxonomy of this family.

Saturn (p. 44)

The New Solar System, edited by J.K Beatty, B. O'Leary, and A. Chaikin (Cambridge: Sky Publishing Corp., 1981), is a collection that brings together the most recent findings about the sun, planets, satellites, and that which lies between. This up-to-date reference work, with an introduction by C. Sagan, includes the first *Voyager* encounter with Saturn and offers coherent explanations of the chemical and thermal history of the solar system, the accretion and fragmentation of its members, and the changing planetary surfaces. Among its twenty articles are "Jupiter and Saturn," by A. Ingersoll, and "Titan," by J. Pollack. The 10 April 1981 issue of *Science* features twelve articles, occupying from pages 159 to 239, that deal with different aspects of the *Voyager* mission to Saturn. It presents the first scientific reports of the flyby of the planet and its satellites and rings, illustrated with many informative photographs, charts, and graphs. *Voyager 1 Encounters Saturn* (Washington, D.C.: U.S. Government Printing Office, 1980, Stock No. 033-000-00817-1), available for sale from

WHETHER RAIN, FOG, OR SUDDEN SQUALL...
Swift Waterproof Binoculars Shine Through.

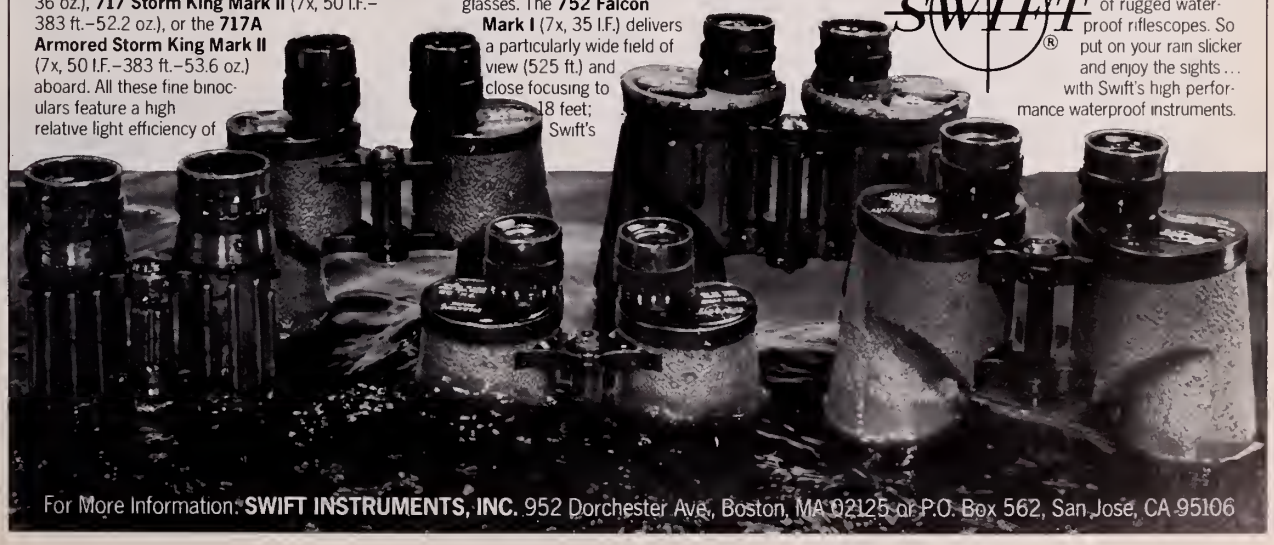
When weather conditions are less than perfect, see your way clear with Swift quality waterproof binoculars.

Seafarers are always prepared with Swift's **753 Sea Hawk Mark I** (7x, 50 I.F.–393 ft.–36 oz.), **717 Storm King Mark II** (7x, 50 I.F.–383 ft.–52.2 oz.), or the **717A Armored Storm King Mark II** (7x, 50 I.F.–383 ft.–53.6 oz.) aboard. All these fine binoculars feature a high relative light efficiency of 84.2, producing razor sharp images even during that unpredictable storm-at-sea.

Sports fans and ornithologists can enjoy the action even under the most adverse conditions when "armed" with Swift's quality waterproof glasses. The **752 Falcon Mark I** (7x, 35 I.F.) delivers a particularly wide field of view (525 ft.) and close focusing to 18 feet; Swift's **820 Armored Trilyte Mark III** (9x, 35 I.F.) offers maximum hand-held power in a compact (26 oz.) wide-field (383 ft.) instrument.

SWIFT®

Swift also has an extensive selection of rugged waterproof riflescopes. So put on your rain slicker and enjoy the sights... with Swift's high performance waterproof instruments.



For More Information: **SWIFT INSTRUMENTS, INC.** 952 Dorchester Ave., Boston, MA 02125 or P.O. Box 562, San Jose, CA 95106

Share the Thrills of Exploring Outer Space!



$359.95 f.o.b. Hartford, Conn.

$15 Crating Charge

Now it's easy to join the thousands of serious amateurs who have discovered the excitement of exploring our mysterious universe. Your enjoyment begins right from the start, yet the challenges and rewards go on for years! And it's a hobby that can be shared at modest cost.

Choose From Many DYNASCOPES®

Picking a telescope to fit your needs and your pocketbook is simple when you select a DYNASCOPE – the same instruments used by more than 150 schools, colleges and observatories – and your satisfaction is guaranteed by a full-refund warranty.

FASCINATING GUIDE YOURS FREE!

Read these valuable facts before buying any telescope. Mail coupon or postcard for your complimentary copy of this helpful guide.



Criterion Manufacturing Co.
620 Oakwood Ave., W Hartford, Conn. 06110

® TM Registered U.S. Pat. Office

CRITERION MANUFACTURING CO., Dept NH 107
620 Oakwood Avenue, W Hartford, Conn 06110
Please send your free Telescope Guide.

Name_____

Address_____

City_____ State_____



CHIPMUNK PORTRAIT

by
B. & H. Henisch

THE CARNATION PRESS
State College, Pennsylvania

An illustrated study of chipmunks and their habits, their discovery in America by early European explorers and naturalists, and their role in the art and folklore of the American Indian.

"Delightful, scholarly, irresistible" (*Scientific American*). "Outstanding title; impossible to bypass; well researched and documented" (*Library J.*) "A certified delight" (*House Beautiful*). "Important contribution" (*J. General Education*).

THIRD PRINTING

Cloth bound, 98 pages, with 45 close-up photographs and 28 pen and wash drawings. $11.95 plus $1 postage & handling. (Pa. residents add 72¢ sales tax).

To the CARNATION PRESS
P.O. Box 101, State College, Pa. 16801

Please supply_____ copies of CHIPMUNK PORTRAIT.

Amount enclosed $_____

Name _____

Street _____

City ___ State _____ Zip _____

the Superintendent of Documents, Washington D.C. 20402, presents the preliminary photographs, accompanied by straightforward, nontechnical explanations, from *Voyager 1*'s encounter with Saturn and its major satellites. "Voyager 1 at Saturn: Riddles of the Ring," by senior writer R. Gore (*National Geographic*, July 1981, pp. 2–31), is a popular account of the *Voyager* mission to Saturn, featuring many color photographs from NASA.

Suriname (p. 54)

S. Price and R. Price's *Afro-American Arts of the Suriname Rain Forest* (Berkeley: University of California Press, 1980), is the first comprehensive study to explore the integration of the arts in everyday Maroon life and trace their development from Africa to the Suriname rain forest. The book has more than 300 duotone illustrations and 21 color plates. A special, NEH-subsidized edition can be purchased from the Museum Shop of the American Museum of Natural History for $8. The Prices have also produced a recording of Maroon music, with extensive ethnographic notes, *Music from Saramaka: A Dynamic Afro-American Tradition* (New York: Folkways Records, 1977). For a general overview of Maroon societies throughout the Americas—from Brazil through the Caribbean and into the southern United States—see R. Price's *Maroon Societies* (Baltimore: The Johns Hopkins University Press, 1979, revised edition). Two books by M.J. Herskovits and F.S. Herskovits, pioneer anthropologists in Afro-American studies, describe their visits to Suriname in the 1920s. *Rebel Destiny* (New York: McGraw-Hill Book Co., 1934) chronicles their two trips to the Saramaka Maroons, and *Suriname Folk-Lore* (New York: AMS Press, 1969, reprint of the 1936 edition) is a compendium of folkloric materials largely from coastal Suriname. For a vivid account of eighteenth-century Suriname society, including depictions of masters, slaves, and Maroons, see J.G. Stedman's *Narrative of an Expedition Against the Revolted Negroes of Surinam*, edited by R.A. Van Lier (Amherst: University of Massachusetts Press, 1972). A new critical edition of this work, including eighty full-page illustrations, many by William Blake, is now being prepared for publication. Edited by R. Price, this edition will be published in both paper and cloth by the University of Minnesota Press in 1982.

In 1974 we originated our epoch-making Galapagos Islands Thrift Cruises, which for several years enabled many hundreds of budget-minded travelers who were interested in ecology, wildlife and photography to see these unique islands without luxurious trimmings but under expert guidance.

We now again offer a budget program which includes some of the highlights which make a visit to this remarkable archipelago such a renowned tourist attraction. We explore five of the islands in order to view sea lions, iguanas and a large variety of birds, such as the famous Darwin's finches, boobies, frigates and gulls.

Galapagos Islands Thrift Program™

APRIL 4 TO 14, 1982
JUNE 27 TO JULY 7, 1982
DECEMBER 26 TO JANUARY 5, 1983

Our program includes easy hikes on Santa Cruz to see tortoises roaming free and to the top of the dormant volcano at Sullivan Bay, and ample opportunities for swimming and snorkeling. It is ideal for young people and families with children and has been planned during periods of school and college vacations.

We do not claim that these programs are as comprehensive as our superb and unrivalled **Discover Galapagos** yacht cruises in August and October, 1982; but our meticulously supervised arrangements do provide you with a fascinating introduction to these wonderful islands—and at a third of the cost.

Each program is accompanied by one of our expert leaders and a naturalist guide who give informative talks and lead us in the field.

Before the week at the islands, we spend two days at the best hotel in Quito, Ecuador's lovely capital in the Andes.

Please send for the detailed brochure of these programs—we also specialize in expeditions to Greenland, Mount Kilimanjaro, the Himalayas and the Andes; wildlife safaris to see polar bears and seals in northern Canada and to Scotland, Borneo and Rajasthan; and archaeological tours to Peru, Morocco and Egypt.

HANNS EBENSTEN TRAVEL, INC
705 WASHINGTON STREET, NEW YORK, NY 10014
TELEPHONE (212) 691 7429

***Natural History* Nice'n Neat**



Slip your **Natural History** issues into permanent files for ready reference. Green leather-like face embossed in gold to look like fine books. It holds one year's subscription. Also for **Smithsonian**, blue, 1 year. **Audubon**, green, 1 year. **Scientific American**, red, 1 year. **National Wildlife**, blue, holds 3 years. Specify title and quantity. Postpaid.

$5.20 ea **$4.63** ea., 3 or more.

Send check or Master Charge or VISA number with exp. date, signature to

Highsmith
Box 25 NAT Ft. Atkinson WI 53538
Catalog of files free with order

Wildlife Adventures

- Whale Watching in Mexico
- Polar Bear Photography
- Tanzania Wildlife Safari
- Gorilla Viewing in Congo

Many other trips

Travel in small groups with the experts

For 81-82 Preview & itineraries contact

Adventures International
4421-AS Albert St.
Oakland, CA. 94619 (415) 531-6564

BOOK HUNTING?

Virtually any book located—no matter how old or long out-of-print. Fiction, nonfiction. All authors, subjects. Name the book—we'll find it! (Title alone is sufficient.) Inquire, please. Write: Dept. 71

BOOKS-ON-FILE P.O. BOX 195
UNION CITY, NEW JERSEY 07087

CATCH THE SUNSHINE



• Beautifully Designed • Permanent Quality
• Solar Efficient
• Sensibly Priced

Write or call for free Color Brochure and "Practical Guide for Greenhouse Selection"
205/432-7529

Gothic Arch Greenhouses

P.O. BOX 1564, DEPT. NH MOBILE, ALABAMA 36633

PERU
CUSCO — MACHU PICCHU
THE AMAZON

The largest variety of tour packages including First Class and Delux hotels, at the lowest price ever.

CALL NOW—TOLL FREE 1-800-223-1367
IN N.Y. CALL COLLECT (212) 582-7811
VALISHA TRAVEL
250 W. 57th. St.
N.Y.C. 10019

Weather and Climate in Tibet (p. 64)

E.R. Reiter's *Jet Streams* (Garden City: Doubleday and Co., Inc., 1967) is the first popular survey of this phenomenon. Beginning with a chapter on the discovery of jet streams, Reiter then explores how they are formed; how they move, are measured, and analyzed; and what effect they can have on weather and climate. Reiter also gives an excellent survey of the basic methods of meteorological investigation. "Rapid Rivers of Air," by E.R. Reiter (*Natural History*, March 1975, pp. 46–51), reviews the effects of jet streams on weather, climate, agriculture, and aviation (see that issue's "Additional Reading," p. 84, for four more references). H.H. Lamb's two-volume *Climate: Present, Past and Future* (London: Methuen and Co., Ltd., 1972) is an essential, authoritative reference work on climate fundamentals and history. This exhaustive study also discusses how to approach such problems as seasonal forecasting and advising on future climatic trends. Part one has 613 pages; part two has 835. The January 1981 issue of the *Bulletin of the American Meteorological Society* contains six articles by scientists who participated in an excursion by jeep across Tibet, organized by Academia Sinica and the Chinese government (pp. 4–36). The articles deal with local and regional meteorological and climatological problems in Tibet. S. Han's *Lhasa, the Open City* (London: Jonathan Cape, Ltd., 1977) is an anecdotal, conversational account of the changes, brought about by the diminished role of the religious elite and the increased role of the former serf class, that occurred in Tibet from 1950 to the present day. Han describes the effects of Chinese Communist influence, which she considers to be especially important and presents in a positive light. "Tibet-in-Exile: Triumph of a People," by J. Avedon, with photographs by E. Haas and D. Mehta (*GEO*, May 1981, pp. 84–110), is about the 85,000 Tibetans who, after a violent, unsuccessful uprising in 1959 against Chinese domination, fled to India with their leader, the Dalai Lama, and created a nation-in-exile.

Rita Campon

Erratum: The caption on page 46 of our August issue incorrectly identifies the avocet (top photo) as engaging in a distraction display, when it is, in fact, performing a two-wing stretch display. This behavior often precedes flight from a disturbance.



CONVERTIBLE BALACLAVA

Soft, warm 100% brushed virgin wool. Wear it up like a watch cap or rolled down to protect ears, neck, forehead and chin. Tucks in your pocket. Built-in visor keeps snow off your goggles. One size fits men, women, youths. **Colors:** Red, Orange, Dark Blue, White or Green. **Balaclava Hat $7.50** ppd.

Order Today! Money Back Guarantee!

Here is my check or money order for $ _____
(Add sales tax where applicable.)
Please RUSH my **#1750 Balaclava Hat.**
Color _____
Name _____
Address _____
City _____
State _____ Zip _____
☐ **Send me your FREE color catalog of quality outdoor apparel and equipment.**

Eddie Bauer®

Dept. KRH, Fifth & Union, Seattle, WA 98124



Art Nouveau pin expresses your romantic nature

Unique sterling silver fashion accessory expresses your romantic and individual nature. Skillfully crafted in Israel with Old World craftsmanship in mind. 1½" diameter. Just $35 (including postage), your satisfaction guaranteed.

Send me _____ sterling silver combination pin/pendant(s) @ $35 each. 4R0043
Name _____
Address _____
City _____ State _____ Zip _____
☐ Cheque or money order enclosed
☐ VISA ☐ MasterCard ☐ American Express
Exp. date _____
Signature _____
☐ YES! Please send me complete catalogue of international treasures, free with my order. ($1.00 separately.)

Willoughby & Taylor Ltd.
International Merchants
2912 Iron Ridge Road, Dallas, Texas 75247
Call Toll-free (800) 323-1718 for charge orders. In Illinois (800) 942-8881. Ask for Operator 102

Darwin's Creatures

by Stephen Jay Gould

THE ZOOLOGY OF THE VOYAGE OF H.M.S. BEAGLE, edited by Charles Darwin. *Nova Pacifica Publishing Co. (P.O. Box 11106, Wellington, New Zealand), Facsimile reprint, 3 vols., $795.00 (including freight).*

Charles Darwin was not a city boy. He grew up in the countryside, attended Cambridge University, and of course, spent five years at sea aboard the *Beagle*. Yet Darwin chose London for his first independent home and lived there for several years, beginning as a bachelor and ending as the young husband of Emma Wedgwood. He claimed a deep antipathy for his new home in a letter to the Reverend Leonard Jenyns in 1837: "This London is a vile smoky place, where a man loses a great part of the best enjoyments in life. But I see no chance of escaping, even for a week, from this prison for a long time to come." If Darwin disliked London so much, what was he doing there?

The answer to this question requires that we abandon the usual image of Darwin, fostered by the photographs of his old age, as a quiet, reclusive, self-effacing, sick (or at least hypochondriacal) man. In London, Darwin was an ambitious, driving, energetic youth just home from a five-year trip around the world. Darwin stayed in London for the same reason that many young people today live, with great reluctance, in New York: he was building his career, and the sources of power, cash, and intellectual influences were concentrated in England's version of the Big Apple.

In particular, Darwin was busy politicking for the proper scientific disposition of his *Beagle* specimens (and—why not, after all?—for the resultant prestige that would accrue to him). This young and untested man wanted to line up the finest taxonomists of his day to describe the varied animals he had collected; above all, he needed cash for a lavish and uniform publication. Indeed, he had written to Jenyns to advance his project and to procure his collaboration:

> It would be more satisfactory to myself to see the gleanings of my hands, after having passed through the brains of other naturalists, collected together in one work. . . . The whole scheme is at present merely floating in the air. . . . I apprehend the whole will be impracticable, without [*sic*, we would write "unless" today] Government will aid in engraving the plates, and this I fear is a mere chance, only I think I can put in a strong claim, and get myself well backed by the naturalists of this place.

(Mr. Jenyns, by the way, deserves our deepest gratitude for far more than describing the *Beagle's* fishes. He had made it all possible in the first place—by refusing Captain FitzRoy's invitation to sail on the *Beagle* and thus opening a job for a young fellow named Darwin.)

Darwin was charming, patient, persistent, and well connected; he succeeded in wringing £1,000 from the Lords



Saffron-cowled blackbird

Coxe–Goldberg Photography



HISTORY REPEATS ITSELF

History repeats itself in the new year by offering you membership in the Museum of Natural History and 12 galvanizing issues of NATURAL HISTORY Magazine at last year's low price of just $15.

☐ **YES**, send me 12 months of NATURAL HISTORY for just $15 (I save $9 over the newsstand rate) and my museum membership which is included in my subscription.

NAME _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

I PREFER TO INCREASE MY SAVINGS AND ENJOYMENT:
☐ Send 2 years at $26 ☐ Send 3 years at $35

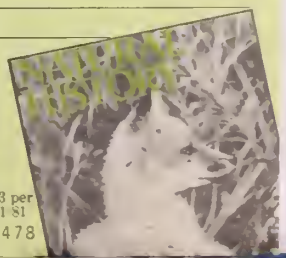
Include a gift membership for:

NAME _____

ADDRESS _____

CITY _____

STATE _____ ZIP _____



NATURAL HISTORY Magazine is published by the American Museum of Natural History, New York, N.Y. Please allow 7 weeks for delivery of first issue. Outside U.S. please add $3 per year for postage. Offer void after 7 31 81

J478

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO. 30 BERGENFIELD, NJ

Postage will be paid by addressee

NATURAL HISTORY
P.O. Box 4200
Bergenfield, New Jersey 07621

Commissioners of Her Majesty's Treasury. *The Zoology of the Voyage of H.M.S. Beagle* appeared in nineteen fascicles (reprinted as three volumes) between 1838 and 1843. England's finest taxonomists described Darwin's specimens—Richard Owen for the fossil mammals, G.R. Waterhouse for the living mammals, John Gould (no relation) for the birds, the Reverend Mr. Jenyns for the fishes, and Thomas Bell for amphibians and reptiles (invertebrates, apparently, didn't count and were described in periodicals or merely allocated to collections). The mammals and birds are illustrated with beautiful color plates, but Her Majesty's munificence must not have extended to "lower" creatures, for the reptiles, amphibians, and fishes appear in dull black-and-white.

The three-volume *Zoology of the Voyage of H.M.S. Beagle* is by far the rarest of all Darwiniana. Its initial printing was small, and it was never reissued. It occupies the stratosphere of antiquarian book catalogs; the last time I looked wistfully at a price, it had just entered five figures—yes, Virginia, for a book! We must therefore rejoice that New Zealand's Nova Pacifica Publishing Company has issued the first facsimile of this precious work—even though joy will remain abstract for all but a few, as a high three-digit price will not generate queues in local bookstores. Still, in a world awash in mediocrity, one can only praise a job so beautifully and lovingly done. The clarity of reproduction, including the rich color of the plates, is stunning, and the volumes are bound in cloth and leather "to a standard almost certainly higher than that of the original" (to quote from the appropriately immodest publisher's note). Thus, we can touch, smell, and feel in this reprint a bit of the finest workmanship from the great age of publication in descriptive natural history.

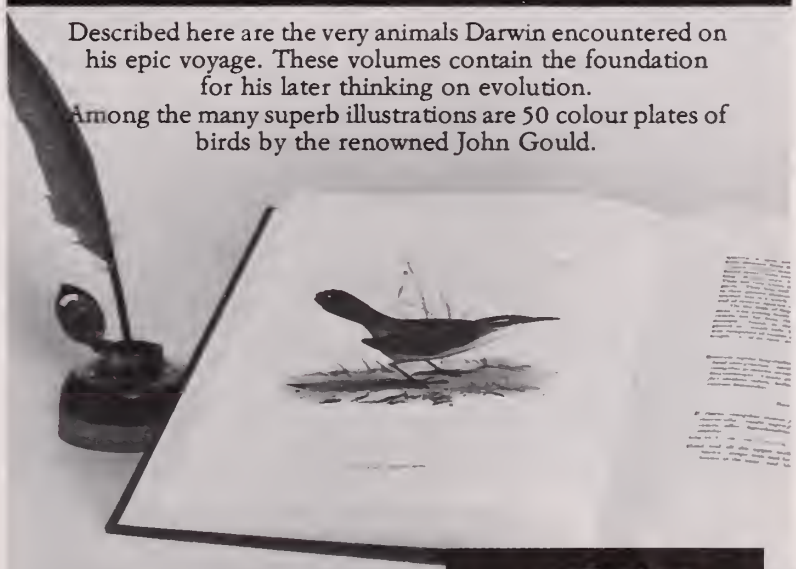
But the *Beagle Zoology* holds far more than a mere antiquarian or aesthetic interest. First of all, it contains descriptions of formidable specimens

A limited number only available

CHARLES DARWIN
THE ZOOLOGY OF THE VOYAGE OF H.M.S. BEAGLE

A three volume, facsimile reprint in a limited world edition of 750 copies.

Described here are the very animals Darwin encountered on his epic voyage. These volumes contain the foundation for his later thinking on evolution.
Among the many superb illustrations are 50 colour plates of birds by the renowned John Gould.



A unique combination of artistic, scientific and collectable value.

Sumptuously produced in 3 volumes. Bound in genuine leather and linen. 1096 pages, (12½" x 9¾"), containing numerous B/W and colour plates. Marbled endpapers.

PRICE US $795.00
Price includes packaging, airfreight and insurance.
American Express, Diners Club and Visa welcome.



Send for a FREE illustrated color brochure
or order from the publisher using the order form below

To: NOVA PACIFICA Publishing Co. Ltd.
P.O. Box 11-106, Wellington, New Zealand.

Please send me a 3 volume set of 'The Zoology of the Voyage of H.M.S. Beagle' at US$795.00
I wish to pay by Bankers Draft (enclosed) I wish to pay by Credit Card (Tick one below)

Card No: ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐
☐ American Express
☐ Diners Club
☐ Visa

Expiry date: .....
Name: ..... Signature: .....
Address: .....
.....

NOVA PACIFICA PUBLISHING CO. LTD., 12-14 ALLEN STREET WELLINGTON, NEW ZEALAND.



Save Your Fireplace!

The Shelburne Fireplace-Stove will transform your open fireplace from an energy waster into an incredibly efficient *heat producer*. You enjoy a visible fire behind safe Corning Pyroceram glass, framed by the graceful ellipse of two cast-iron doors.

Downdraft combustion, space-capsule insulation, a 40" baffle system are just three reasons why the Shelburne is the world's most highly engineered fireplace stove. Fits 80% of all fireplaces — and it rolls-out on concealed wheels for easy chimney cleaning!



Send $1 for color literature portfolio and insulation sample:

VERMONT STOVE COMPANY
Dept. 2419, Rte. 7
Shelburne, VT. 05482
(802) 985-2592

Pats. pending
1981 Vermont Stove Co.

100% Alpaca Blankets

Baby alpaca, the natural fiber luxury once reserved for Inca royalty. Handcrafted in the Andes of Peru, our exclusive, seasonless blankets are softer than cashmere (at half the price); warmer than wool, but featherweight. In rich earthtone stripes, or solid champagne.

----- ORDER TODAY - MONEYBACK GUARANTEE -----

TOLL FREE 800 228-2606 with credit card or send check, M.O., VISA, M.C., AMEX.

☐ **Alpaca Blanket** 86"x65" **$189** (3.50 ship)
☐ **Alpaca Throw Blanket** 75"x57" **$145** (3.25 ship)
☐ **Andean Padre Hat.** Wool felt w/satin trim. Taupe, brown, navy, copen, vicuña or black. S, M, L. **$35** (2.50)

☐ Send **FREE** alpaca blanket swatch and **COLOR CATALOG.**

La Raya Pass, elev. 15,000 ft., Peruvian Andes.



the peruvian connection
1 Canaan Farm Sta. (913) 845-2780
Tonganoxie, Kansas 66086

by formidable people. In 1837 Darwin had written in his notebook: "In July opened first notebook on Transmutation of Species. Had been greatly struck from about the month of previous March on character of South American fossils, and species on Galapagos Archipelago. These facts (especially latter), origin of all my views." The *Beagle Zoology* contains formal descriptions of all these specimens—the giant fossil mammals by Richard Owen, the greatest paleontologist of nineteenth-century Britain; Darwin's finches by John Gould, England's premier ornithologist.

Secondly, the *Beagle Zoology* contains much more of Darwin than I and most historians realized (most of us, after all, never had the opportunity to see a copy of the work before this reprint, and we acted on hearsay and supposition). I knew that Darwin had been an active entrepreneur and had, of course, collected all the specimens, but I thought that very little of his own words or ideas were represented in the volumes. Not at all. Darwin wrote the geological section of Owen's monograph and a geographical introduction to Waterhouse's work. Almost half of Waterhouse's text contains verbatim transcriptions of Darwin's field observations on the habits and distribution of the animals he collected. John Gould described all the birds in the formal Latin then favored in taxonomic work (long lists of characters, all in the ablative), but he left for Australia before finishing the work. Darwin therefore wrote or edited most of the text and again provided long commentaries on his field observations.

We learn much about Darwin as a person and can only admire his honesty and enthusiasm. He revels in the abundance of giant vertebrate fossils when writing that "any line whatever drawn across the Pampas would probably cross the skeleton of some extinct animal." He faces his own shortcomings and inexperience in admitting that he had not appreciated the significance of his finches when in the Galápagos. (He had not even recognized them as close relatives or realized that many species were confined to individual islands. In fact, Gould's taxonomy—published here—first revealed the tale that Darwin would later exploit; he had not "seen" evolution in action while he visited the Galápagos.) "Unfortunately," Darwin writes, "I did not suspect this fact until it was too late to distinguish the specimens from the different islands

For the fifth year, we invite adventurous travelers to join us on a unique travel experience:

The Snows of Kilimanjaro

FEBRUARY 5 TO 22, 1982

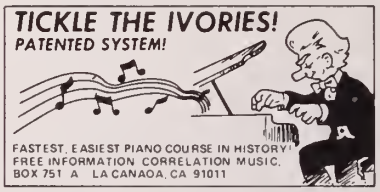
Our expedition begins with a wildlife safari to Ngorongoro Crater, the Serengeti Plains and Lake Manyara, where we also undertake hikes to prepare us for the ascent of Africa's highest mountain, crowned with its permanent icecap.

In order to make the climb not only memorable but enjoyable, we allow plenty of time for resting at huts and camps to become used to the high altitude.

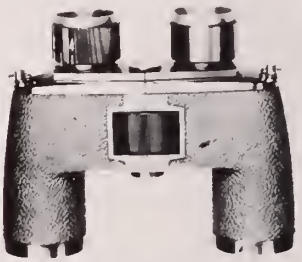
Detailed brochure of the expedition and a copy of our newsletter which lists all our fascinating travel programs, available from:

HANNS EBENSTEN TRAVEL, INC
705 WASHINGTON STREET, NEW YORK, NY 10014
TELEPHONE (212) 691 7429

TICKLE THE IVORIES!
PATENTED SYSTEM!



FASTEST, EASIEST PIANO COURSE IN HISTORY!
FREE INFORMATION. CORRELATION MUSIC.
BOX 751 A LA CANADA, CA 91011



BUSHNELL 7x35 CUSTOM
Mfg. List $280.00 **Postpaid $164.00**

This is an example of the deep discount prices on high quality optics that is found in our FREE catalog. This catalog lists and illustrates an outstanding selection of telescopes, binoculars etc., plus valuable information on how to properly select them. Write for it today.

GIL HEBARD OPTICS
COURTHOUSE SQ., KNOXVILLE, ILL. 61448

Crossroads of Evolution

Galapagos

Cruise Darwin's "enchanted island" by private yacht. Photograph unusual wildlife. Enjoy stimulating lectures by naturalist/guides. Visit artistic Cuenca on mainland Ecuador. 15 days. Write for details.

Society Expeditions
Dept. NH9
723 Broadway East
Seattle, WA 98102

Name
Street
City / State / Zip

Please include: ☐ New Guinea ☐ Galapagos ☐ Mongolia ☐ Tunisia ☐ Antarctica ☐ Amazon ☐ New Guinea & Melanesia ☐ New Guinea & Indonesia ☐ Singapore to Seychelles ☐ Arabia ☐ Iceland & Greenland ☐ N. & West Africa ☐ China

SRI LANKA

The island of Serendip in the Indian Ocean better known to you as Sri Lanka or Ceylon offers you the most unexpected discoveries.

You will see in this resplendent land one of the world's oldest cultures and marvel at its ancient cities, built before Rome was founded.

Optional excursions to the architectural splendors of North & South India and the Himalayan Kingdom of Nepal; the coral formations and tropical atolls of Maldive Islands, wild life parks where you can see leopard, the rare black deer, loris, elephant and various other species of animals and birds; golden unspoiled beaches of Bentota and Trincomalee.

For brochures write to:

JOURNEYWORLD
155 East 55th St., New York, N.Y. 10022
Tel (212) 752-8308



112 Pages of Dolls, Toys and Miniatures from Vermont

Browsing through our 1981-82 color Catalog is like strolling through the 12 magic-filled rooms of our Colonial Store in Manchester Center.

You'll discover more imaginative Dolls, Toys, Books and Games than you ever dreamed existed! PLUS the North Country's largest selection of Dollhouses and hundreds of exquisite Miniatures.

For your Catalog send $2.00 (refundable) to:

the enchanted doll house
45091 Deer Meadow
Manchester Center, Vt. 05255

BAUSCH & LOMB



SPORTS OPTICS

When it comes to optics, the Bausch & Lomb name has had no peers for over 100 years. Their binoculars, riflescopes and telescopes remain the standard of excellence against which all others are judged. Invest in a Bausch & Lomb, and you've made the buy of a lifetime.

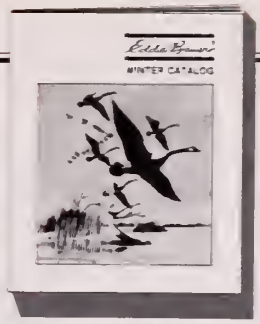
WRITE FOR LITERATURE AND DISCOUNT PRICES ON A COMPLETE LINE OF OPTICS FOR THE NATURALIST

Danley's POST OFFICE BOX 1-E FORT JOHNSON, N.Y. 12070

in the group, but from the collection made for Captain FitzRoy, I have been able in some small measure to rectify this omission." (FitzRoy had upstaged Darwin by labeling his specimens more completely.) In another passage, Darwin tells of stalking the petise, a small rhea previously unknown to science. But when a member of the *Beagle* crew finally shot one, Darwin didn't recognize what he had and ate his new species: "I looked at it, and from most unfortunately forgetting at the moment the whole subject of the Petises, thought it was a two-third grown one of the common sort. The bird was skinned and cooked before my memory returned. But the head, neck, legs, wings, many of the larger feathers, and a large part of the skin had been preserved."

More importantly, numerous passages scattered throughout the work give us important insight into the characteristic—and often quite individualistic and unusual—modes of thought that would later foster Darwin's evolutionary theory. Thus, the *Beagle Zoology* will also provide new information for Darwin scholars in the most vital area of all, especially important because so few historians have ever seen these passages. Consider just a few examples:

1. Darwin writes in his geological introduction to Owen's monograph: "In this part of South America there is reason to believe that the movements of the land have been so regular, that the period of its elevation may be taken as an element in considering the age of any deposit." In other words, upward motion by earthquakes, averaged over time, has been sufficiently uniform in rate that the height of a stratum above sea level will indicate its age. Now what Darwin actually saw in South America was the cataclysmic devastation wrought by local earthquakes. Yet he chose to focus his attention on the potential smoothing out of local catastrophes over long stretches of time to yield uniform average rates, rather than on the more literal extrapolation of local terror to a catastrophic theory of earth history. Here we clearly see the influence of Lyell (who treated earthquakes and volcanoes in the same way) and his so-called uniformitarian approach, an essential ingredient of Darwin's developing gradualism. Aside from natural selection itself, gradualism became the most pervasive and controlling aspect of Darwin's world view.



FREE CATALOG

Celebrating Our 61st Year

Our new Winter Catalog features the finest in outdoor clothes and equipment. Every one of the more than 600 products is backed by our Unqualified Guarantee of Complete Satisfaction or Your Money Back.

☐ **YES! Send me your FREE Winter Catalog.**

Name _____
Address _____
City _____
State _____ Zip _____

Eddie Bauer®
Dept. KLH, Fifth & Union, Seattle, WA 98124

THOSE *of the* GRAY WIND
***THE* SANDHILL CRANES**
Paul A. Johnsgard



Keenly observant and elegantly told, Paul Johnsgard's tribute to the sandhill cranes skillfully evokes the awe and fascination that generations have felt for these magnificent birds. "A gem of a story by a distinguished wildlife biologist."
—Roger Tory Peterson
Illustrated with exquisite drawings, $8.95

ST. MARTIN'S PRESS
175 Fifth Avenue New York, N.Y. 10010

For the ninth year we offer intrepid travelers the world's most challenging and rewarding tourist experience

Greenland Dog-sledging Expeditions

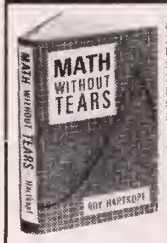
MARCH 27 TO APRIL 13, 1982

Two weeks are spent on Greenland's breathtaking West Coast under the expert guidance of a leading Arctic explorer. Travel is by helicopter and husky-drawn sledges.

Detailed brochures of this expedition and a copy of our newsletter which lists all our fascinating travel programs available from:

HANNS EBENSTEN TRAVEL, INC
705 WASHINGTON STREET, NEW YORK, NY 10014
TELEPHONE (212) 691 7429

MATH WITHOUT TEARS



Using non-technical language and a light touch Roy Hartkopf gives you a basic understanding of many everyday applications of mathematics. He takes the reader from simple counting to trigonometry and calculus, emphasizing the practical aspects of math. Humorously written. *Learn math in the comfort of your own home at minimum cost.*

Order Now $10.95 plus $1.10 hdlg
EMERSON BOOKS, INC.
Dept 870-F Buchanan, N.Y. 10511
10 Day Money Back Guarantee

OST CRAVATS

OST Cravats Inc., Dept. G2
502 West Lantana Road
Lantana, Florida 33462
(305) 586-3322

A PERSONAL NECKWEAR SERVICE



FREE 24 page color catalog of new and traditional neckwear in Open Collar and Four in Hand styles. Fine imported silks and polyester meticulously tailored at prices not available at retail. Just mail coupon or phone for the only catalog of its kind in the world. **FREE**

☐ Please send free catalog

Name _____
Address _____
City _____
State _____ Zip _____

We also design and make CORPORATE TIES to order. Enquiries invited • 150 minimum.

2. Discussing the unusual habits of the rhea, Darwin states that females lay eggs in several nests and that males then incubate them. In wondering how such a system began, he writes: "It is evident that there must at first be some degree of association, between at least two females; otherwise the eggs would remain scattered at distances far too great to allow of the male collecting them into one nest." Here Darwin uses a primary style of evolutionary thinking: faced with an "odd" adaptation, one must discover (or at least postulate) intermediary stages bridging the gap between ordinary ancestor and peculiar descendant. In thinking about how rheas developed their unusual system, Darwin neither invokes God's wisdom in design nor waxes eloquent about adaptive value. Already, he asks the evolutionist's historical question: How did such a system arise from more ordinary avian conditions? He argues for physical continuity (or evolution, if you will) by suggesting a rudimentary incipient state of loose association between females.
3. Darwin claims that the frigate bird "never touches the water with its wings, or even with its feet." Yet, its feet are webbed, and Darwin writes: "It appears that the deeply indented web between its toes is of no more use to it, than are the shrivelled wings beneath the wingcases of some coleopterous beetles." In Waterhouse's monograph, Darwin discusses the tucutuco, a burrowing rodent with apparently well-developed eyes, yet often found blind. Darwin writes: "Considering the subterranean habits of the Tucutuco, the blindness, though so frequent, cannot be a very serious evil; yet it appears strange that any animal should possess an organ constantly subject to injury."

   In both these examples, Darwin faces directly and wonders powerfully about the primary category of evidence for the fact of evolution: structures now useless (perhaps even marginally harmful) that "make sense" only as the retained product of a previous history (as water bird or terrestrial rodent).
4. In discussing the rats of Ascension Island, Darwin notes that animals from the mountain summit are black and glossy while those on the sea beach are browner. He suspects that these differences have arisen by local modification (a reasonable view, even for a creationist who would not deny, after all, the common sources of dog and cattle breeds). But Darwin then makes the crucial evolutionist's step of extrapolating local differentiation to cases of change at larger scale. If these local races arise naturally, then Ascension rats (designated by Waterhouse as a new species!) may only represent a "strongly marked variety" of ordinary rat "brought, by some ship, from some unknown quarter of the world." Two pages earlier, Darwin offers the same explanation for differences between common and Galápagos rats, where again Waterhouse had named a new species: "And if a very peculiar climate, a volcanic soil, and strange food, can together produce a race, or strongly marked variety, there is every probability of such change having taken place in this case."

Waterhouse interpreted these situations in a conventional, creationist manner. Differences between common and Galápagos or Ascension rats do not imply directed evolutionary change that might be extrapolated to events at larger scale. The common rat is a perfectly good, stable species; it merely has an uncommonly broad capacity for variation, as do all forms "which follow man in his peregrinations, and which, to a certain degree, are dependent upon man." "Like really domestic animals," Waterhouse states, these rats "are subject to a greater degree of variation than those species which hold themselves aloof." Darwin, on the other hand, is clearly wondering about the arbitrary boundary of species and the extrapolation of small into larger effects that transgress the limits of species and must record evolution.

The *Beagle,* by extension, must have had a wonderfully salutary effect upon those who dedicated themselves to its animals. In an age of limited life expectancy, Darwin himself died at 73. But the five monographers of *Beagle Zoology* did even better. John Gould died at 77; Waterhouse at 78. Owen and Bell lived to 88 and Jenyns reached 93. If these rewards were insufficient, we may rejoice that all these men now live again in the surrogate form of the most beautiful reprint in years.

Stephen Jay Gould, who writes "This View of Life" for Natural History, *teaches biology, geology, and the history of science at Harvard University.*

Portugal.
Everybody calls it Europe's greatest value.
We call it home.



They're right. Portugal is the greatest travel bargain in Europe. But it takes the special knowledge of the Portuguese to really get to know our special places and get the most enjoyment from them.

Starting with TAP Air Portugal, we make it easy to get to our beaches and castles, islands and mountains. We'll point out the places to see, things to do and where to sample a life that's loaded with pleasures, but not price tags.

Send in the coupon, we'll give you the details that make travel in and to Portugal the vacation experience of your dreams. At prices you can afford.

We're sure you'll love Portugal almost as much as we do.



Portuguese National Tourist Office

TAP AIR PORTUGAL

Portugal

TAP Air Portugal
Tour Department
1140 Avenue of the Americas
New York, N.Y. 10036
Call toll-free 800-223-2406
In New York call (212)944-0200

DMO 90981

Please tell me more about the values I can enjoy in Portugal

Name _____

Address _____

City _____ State _____ Zip _____

Roots

The leaves, bark, and roots of the sassafras tree were believed to have medicinal properties

by Raymond Sokolov

Some years ago, I passed through New Orleans and the French West Indies investigating their Creole cuisines. Like the word *Creole* itself (derived from a Portuguese word meaning "create"), so-called Creole cooking was a complex notion, too complex, in fact, to talk about as a single phenomenon. In Louisiana, Creole food was one thing; in Martinique and Guadeloupe, it was a very different sort of adaptation of European food ideas to New World conditions, to products of this hemisphere, and to exotic methods and ingredients brought by black slaves from Africa. Certainly, no kitchen shelf in Fort de France could boast any of the green, powdered spice I had bought in New Orleans and stashed in my suitcase.

Distracted by such Antillean delicacies as *blaff,* the pungent fish stew, I forgot about the powder I was carrying and about the New Orleans gumbos it is frequently used to thicken. In the French West Indies, gumbo (in French, *gombo*) does not refer to a thick stew served over rice. *Gombo* is okra, reflecting the original name for that green pod (the source of my green powder) among the Kimbundu-speaking people transported from Angola by slavers. Our word *okra,* now the common name for *Hibiscus esculentus* in the United States, comes from another West African language, Tshi. "Gumbo" survived in our vernacular only as the name for the stew because in some recipes, okra, which turns ropy when cooked, is used to thicken the gumbo broth.

These intricacies were entirely lost on the United States Customs agent who extracted the bottle of green powder from my luggage at Kennedy Airport, beaming as only a Customs agent can beam when he is sure he has caught someone smuggling marijuana.

"What might this be?" he asked with a twinkle.

"Filé," I said pointing to the label.

"Oh, is that what they call it in French?"

"Yes, it means ropy, because it turns viscous and ropy when you cook with it. I bought it in New Orleans, where they use it in gumbos when they're not using okra for the same purpose."

The man took the bottle and went away to an office. Perhaps he gave it to a specially trained, marijuana-detecting bloodhound to sniff. I devoutly hope he tried to smoke some. Whatever method of analysis he used, it convinced him I was not trying to import a potent drug. He returned with the bottle and waved me back into the country.

Ironically, it was as a drug that filé first came to prominence in the world. Filé is prepared from the leaves of the sassafras tree, *Sassafras albidum,* whose aromatic bark and leaves and roots were highly sought after in the early days of exploration for their supposed medicinal properties. Gerard's *Herbal* (1597) asserted that "The roote of sassafras hath power to comfort the liver, and to dissolve oppilations, to comfort the weake and feeble stomacke, to cause a good appetite, to consume windiness, the chiefest cause of cruditie and indigestion, stay vomiting, and make sweete a stinking breath."

Gerard had much more to say about the beneficial qualities of this native American tree, which explorers found growing from southern Maine to Florida and west to the Mississippi. There seemed to be almost no human ill it would not cure, from plague to syphilis. Prices for this new-found panacea skyrocketed, and it rapidly became one of the chief early American exports to Europe. Annals of late-sixteenth-century exploration are full of excited accounts of discoveries of stands of sassafras. Walter Raleigh did his best to claim a monopoly on East Coast sassafras trade; in 1602, he confiscated a cargo brought back to England by an independent expedition to Cape Cod.

Indians had helped the men on that voyage harvest sassafras on Cuttyhunk Island off what is now New Bedford. They were already convinced of the curative powers of sassafras tea, and their British visitors were given concrete proof of its benefits when one of them took it to relieve a bellyache brought on "by eating the bellies of Dogfish, a very delicious meate."

Eventually, as Thoreau wrote, sassafras "lost its reputation." That is, it was no longer prescribed for infectious diseases, and the bottom fell out of the market. But even today, sassafras tea is sold in health-food stores. I recently brewed some and found it mild, appealingly red in color, and unremarkable in flavor. On the other hand, sassafras trees are quite remarkable. They reach a height of ninety feet in the Great Smoky Mountains and may live for 1,000 years. They produce three kinds of leaves, some lance shaped and entire, some three lobed, and some that are mittenlike with an oblique lobe on either side. Old trees have deeply furrowed, reddish brown bark, tinged with ash gray. The wood itself is reddish. Branches spread almost at right angles from the trunk and support smaller vertical branches.

Not only did the Indians teach the settlers to use the various parts of these magnificent trees for teas and gumbo thickening, but the settlers quickly began adapting sassafras to a recipe they had brought with them from Europe. With the bark, they brewed beer.

In colonial days, sassafras beer was only one of several "root" beers decocted from things growing in the woods. Birch beer, spruce beer, and sarsaparilla beer were all common early American beverages produced with roughly

the same simple techniques European farmers used to make beer from barley. But these tree-derived drinks had a negligible alcohol content, and they were thought to have medicinal, or tonic, properties. This is why even today in New England carbonated drinks are called tonics.

Modern manufacturers make their soft drinks fizz by forcing carbon dioxide into them under pressure. And the soft drinks we buy are truly soft because they are not fermented. Traditional root beer and the other sylvan beers were genuine beers, in the sense that their bubbles arose naturally as a byproduct of yeast fermentation.

A typical colonial recipe for root beer began with the making of a syrup. People boiled molasses and water, say one and a half gallons of molasses to five gallons of water, and then let the syrup cool for three hours. Into the syrup went a quarter-pound each of sarsaparilla root, bruised sassafras bark, and birch bark, which added a wintergreen flavor. Finally, our forefathers stirred in a cup of yeast and enough water to top off the vat at sixteen gallons.

The mixture was then allowed to ferment for twelve hours. Finally, when drawn off and strained, the root beer went into kegs or other sealed containers and continued to build up its fizz through secondary fermentation.

Usually the alcohol content of such old-time root beers remained below 2 percent, too low to be intoxicating. Some intrepid root brewers prolonged the initial fermentation so that the alcohol level rose as high as 10 percent, enough to make them feel silly. But under normal circumstances, root beer and the other forest beverages were low in alcohol and were classified as small beers. During Prohibition, root beer substituted for illegal malt-and-hops beer and was sold out of kegs in bars.





THE MUSEUM SHOP

For your holiday gift giving, remember the Museum Shop. You can visit us or mail this coupon for a new fall catalog.

American Museum of Natural History
Museum Shop Catalog, Department NH
CPW at 79th St.
New York, N.Y. 10024

Name _____

Address _____

City _____

State _____ Zip _____

Some commercial breweries switched over to making root beer.

By then, it was no longer necessary to decoct flavorings from roots and barks as part of the actual brewing process. Chemists had learned to extract the essential oils of sassafras and wintergreen in the early nineteenth century. Later, they discovered methyl salicylate, a chemical also known as artificial oil of wintergreen.

Modern root beer manufacturers also dispense with molasses and resort to caramel coloring, which is sometimes souped up with soybean protein to make something known as foaming-type caramel. This is only one of several agents employed to give root beer a foamy head. Manufacturers also mix in a small amount of citric acid as a preservative that attacks bacteria responsible for cloudiness, syrupyness, and ropyness.

If all this organic chemistry makes you never want to drink root beer again, you can, without much trouble, hunt down a bottle of root beer extract at your local country store and brew your own. Or if that isn't natural enough, you could start from scratch, locating a sassafras log and stripping the bark. For an even more authentic and sophisticated flavor, extirpate a sarsaparilla shrub (*Smilax glauca*), dry the bitter roots and throw them into the caldron along with stems and leaves of the wintergreen (*Gaultheria procumbens*) or the young bark of the sweet birch (*Betula lenta*).

These other plants are not only traditional but entirely safe. Natural sassafras, however, is something you will probably want to avoid. Experiments conducted more than twenty years ago showed that the major constituent of oil of sassafras, a chemical called safrole, caused liver damage in dogs and cancer in rats and mice. The Food and Drug Administration banned safrole, which forced root beer manufacturers to forego the use of oil of sassafras altogether. One soft drink executive told me that the flavorings he now uses, such as oil of sweet birch, are not nearly as tasty as sassafras.

More recently, sassafras bark was banned for sale as sassafras tea unless it has been processed to make it safrole-free. Federal labeling requirements do not oblige manufacturers to state whether sassafras tea has been purified of safrole, but in any case, it seems pointless to buy the stuff. Either it is dangerous or it has had its principal flavoring element removed.

Only filé remains safe and available in its traditional form. Or at least that seems to be the case. Composed only of pulverized sassafras leaves, this spice either retains its potency after safrole removal or it does not naturally contain enough safrole to be banned. Without laboratory analysis, it is impossible to determine which is the case.

One thing is sure. Sassafras trees themselves are harmless as long as you don't chew them. Myself, when I need a panacea to ward off civilization's discontents, I sidle up to an *S. albidum* in the woods, break off a sprig, and inhale the aroma, following the example of the Onondaga Indians, who called sassafras twigs "smelling sticks."

Raymond Sokolov, a writer with an interest in the history and preparation of food, is editor of Book Digest.

Mrs. Pat Cashman's Turkey and Sausage Gumbo

- 1 turkey carcass (preferably from a smoked turkey), with a little meat left on
- ½ cup oil
- ½ cup flour
- 1½ large onions, peeled and chopped
- ½ green pepper, stemmed, seeded, and chopped
- 1 rib celery, chopped
- 1½ pounds smoked sausage (such as kielbasa), cut into 2½-inch rounds
- Salt
- Red and black pepper
- ¼ cup chopped parsley
- ¼ cup chopped scallion tops
- 2 cups rice, cooked
- 4–5 teaspoons filé

1. Cover carcass with water, bring to a boil, and simmer until meat begins to fall off bones, about one hour.
2. Remove carcass from broth and pick the meat off. Discard carcass and reserve meat and broth.
3. In a heavy iron pot, heat oil and stir flour into it. Reduce heat to low and stir mixture until it turns medium brown. This is a roux.
4. Add onion, pepper, and celery to roux. Cook until vegetables are tender, stirring constantly.
5. Add 2 to 3 quarts broth (add water to bring liquid up to the minimum 2 quarts, if necessary), sausage, and turkey meat. Bring to a boil, reduce heat and simmer for one hour.
6. Season gumbo to taste with salt and pepper. Stir in parsley and scallion tops. Cook 10 minutes longer.
7. To serve, put a portion of rice in a soup bowl (one per guest) and ladle gumbo over it.
8. Pass filé so that guests can thicken gumbo to their taste. Figure on approximately ½ teaspoon filé per guest.

Yield: 8–10 servings

Mrs. Vernon M. Ventress, Jr.'s Wild Duck, Sausage, and Oyster Gumbo

- 1 cup oil or bacon drippings
- 1 cup flour
- 4 onions, peeled and chopped
- 4 celery ribs, chopped
- 1 bell pepper, stemmed, seeded, and chopped
- 3 garlic cloves, minced
- ¼ cup parsley, chopped
- 1 pound smoked sausage (such as kielbasa), cut in ¼-inch rounds
- 4 wild ducks, cut up for frying
- 2 bay leaves
- 2 teaspoons salt
- Black pepper
- Cayenne pepper
- 3 pints oysters
- 2 cups rice, cooked
- Filé
- Chopped scallions

1. In a heavy iron pot, heat oil, stir in flour, cook over low heat, and stir constantly to make a brown roux.
2. Add onions, celery, bell pepper, garlic, and parsley and cook until tender, stirring constantly.
3. Add sausage and duck pieces. Cook until browned.
4. Stir in 4 quarts hot water, bay leaves, salt, and peppers. Bring to a boil, reduce heat and simmer, covered, for two hours or until duck is tender.
5. Add oysters and one-half of oyster liquor. Simmer uncovered for thirty minutes.
6. Put a portion of rice in each guest's bowl. Ladle gumbo over the rice and pass chopped scallions and filé as complements. Figure on about ½ teaspoon filé per guest.

Yield: 8 servings



INTRODUCING JETTA DIESEL: IT'S FOUR OF THE BEST MILEAGE CARS IN AMERICA.

Wait a minute.

How can we say that one car is four of the best mileage cars in America?

Easy.

Because the new Jetta Diesel is literally four Volkswagens in one.

When you fill it up, the Jetta Diesel's incredibly economical like our Rabbit Diesel, the best mileage car in America.

In fact, it gets an EPA estimated 41 mpg, 57 mpg highway estimate. (Use "estimated mpg" for comparisons. Your mileage may vary with weather, speed and trip length. Actual highway mileage will probably be less.)

When you load it up, the Jetta Diesel's spacious like our Dasher Diesel Wagon. With enough room and luxury so it won't cramp your style—or your passengers—on long trips.

57 hwy est 41 est mpg

And when you rev it up, the Jetta Diesel handles a lot like our sporty Convertible. Because, despite its economical diesel engine, it is a lot like our Convertible, thanks to its rack-and-pinion steering, front-wheel drive and 4-wheel independent suspension.

But perhaps the most impressive thing about the Jetta Diesel is that it's like a Jetta Diesel. Which means that it gives you sleek European styling, sophisticated German engineering and a trunk large enough to handle 8 suitcases.

So you see, having a Jetta Diesel really is like having four of the best mileage cars in America.

Except you only need one parking place.

ALL OUR BEST IDEAS IN ONE CAR. JETTA.

© 1981 VOLKSWAGEN OF AMERICA

THE TASTE BEYOND 12-YEAR-OLD SCOTCH



Discover more.

Let your mature taste lead you from the finest premium Scotch on up to the most expensive 12-year-old Scotch in the world. The Glenlivet. The ultimate in Scotch.

Most premium Scotch is blended and depends on several whiskies for taste and smoothness.

Yet the unblended character of The Glenlivet is noble enough to stand alone. In this distinctive Scotch whisky you'll experience an exceptional smoothness and full-bodied richness, unmatched in all other premium Scotch.

Try the taste beyond premium Scotch.

The Glenlivet
Unchanged since 1824.

5.06(747)N1
Ref.



KEEPING WARM

A Special Issue on Surviving Winter's Worst

10/81

FOR ART'S SAKE.





Just published.
The world's
first collector's guide
to Waterford. A huge
256-page book.
The volume is
a work of art itself,
filled with intriguing facts
and color photography
of old and new Waterford.
Reserve your copy. $50.
At the Waterford Gallery
in your favored store.

WATERFORD®





Photos Pesin

NATURAL HISTORY

Vol. 90, No. 10, October 1981

American Museum of Natural History
Robert G. Goelet, President
Thomas D. Nicholson, Director

2 Authors

8 This View of Life *Stephen Jay Gould*
A Visit to Dayton

The Science—and Art—of Keeping Warm

How do people, plants, and animals survive cold weather? Beginning on page 24, this special issue of Natural History *explores the diverse ways of sustaining life at low temperatures.*

32 Thermal Necessity *Lisa Heschong*

38 Hearth and Home in the Old Stone Age *Catherine Perlès*

42 Eskimos Are Warm People *Text and photographs by Fred Bruemmer*

50 Enduring Cold the Japanese Way *Amanda Mayer Stinchecum*

58 Shivering Finches *Cynthia Carey and Richard L. Marsh*

64 A Bear in Its Lair *Lynn Rogers*

75 Flowers That Make Heat While the Sun Shines *Roger M. Knutson*

82 Plants in High Places *William Dwight Billings*

90 Clothing for Cold Climes *John V.E. Hansen*

98 Come, Gather Round the Chimney *Jane C. Nylander*

104 House Warming *Edwin Kessler*

110 Indoor Air Pollution *Colin High*

118 Books in Review *J. Max Bond, Jr.*
Transparent Solutions

122 Additional Reading

126 Celestial Events *Thomas D. Nicholson*

128 At the American Museum
The Margaret Mead Film Festival

135 A Matter of Taste *Raymond Sokolov*
Sunbelt Cuisine

Cover: *The Eskimos in this camp at Bathurst Inlet are culturally adapted to the cold and inclement weather of the central Canadian Arctic. Photograph by Fred Bruemmer. Story on page 42.*

Alan Ternes, Editor
Judith Friedman, Managing Editor
Thomas Page, Designer
Board of Editors: Carol Breslin, Sally Lindsay, Frederick Hartmann, Vittorio Maestro, Rebecca B. Finnell
Florence G. Edelstein, Copy Chief
Rita Campon, Copy Editor
Kay Zakariasen, Picture Editor
Douglas J. Preston, Publications Editor
Lillian Berger
Editorial Advisers: Malcolm Arth, James W. Atz, Niles Eldredge, Kenneth L. Franklin, E.Craig Morris, Norman Newell, Thomas D. Nicholson, Martin Prinz, Gerard Piel, Nina Root

David D. Ryus, Publisher
Bradford D. Smith, Business Manager
Frederick E. Grossman, Production Mgr.
Debra Buck McCord, Asst. Production Mgr.
Ernestine Weindorf, Administrative Asst.
Elaine M. Callender, Advtg. Production Mgr.
Lauren Krenzel

Bob Bruno, Fulfillment Mgr.
Ramón E. Alvarez, Circulation Asst.

NATURAL HISTORY *(ISSN 0028-0712), incorporating Nature Magazine, is published monthly by the American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024. Subscriptions: $15.00 a year. In Canada and all other countries: $18.00 a year. Second-class postage paid at New York, N.Y. and at additional offices.*

Copyright © 1981 by American Museum of Natural History. All rights reserved. No part of this periodical may be reproduced without written consent of Natural History. *The opinions expressed by authors do not necessarily reflect the policy of the American Museum.* Natural History *is indexed in* Reader's Guide to Periodical Literature.

Advertising Offices:
Natural History Sales
488 Madison Avenue
New York, N.Y. 10022
President of Sales, Arthur Hill Diedrick
Advertising Manager, Katherine José

Telephone Numbers:
Advertising Sales (212) 826-9467
Museum Information (212) 873-4225
Subscription Orders (800) 247-5470
(800) 532-1272 (in Iowa)

Change of address notices, undeliverable copies, orders for subscriptions, and other mail items are to be sent to
Natural History Membership Services
Box 4300
Bergenfield, New Jersey 07621

Authors



While working on the design of a solar building, **Lisa Heschong** became intrigued with how thermal qualities—warm, cool, humid, airy, radiant, cozy—could be used, like light, as an effective element of design. In her book *Thermal Delight in Architecture*, an excerpt from which introduces this special issue of *Natural History*, she has explored how people perceive hearths, gardens, and other places whose strong thermal qualities have special cultural associations. Heschong, who has a master's degree in architecture from the Massachusetts Institute of Technology, is a solar designer and a technical editor for *Solar Age* magazine.



On the subject of being cold, **Fred Bruemmer** can be considered an expert. He writes that he has "lived with the Eskimos in Alaska, the Canadian north, and in Greenland during more than twenty years of fieldwork, often for as much as seven months of the year. Naturally, when one is cold and miserable, the subject of how to keep warm tends to be uppermost in one's mind." He has, consequently, studied the various means that the Eskimos have evolved to enable them to live in reasonable comfort in a land with an extremely uncomfortable climate. Bruemmer has recently returned from the High Arctic, where he spent the summer investigating the behavior of beluga whales.

Fascinated by the symbolism of fire in Siberian tribes, **Catherine Perlès** began to do research on the discovery and use of fire in prehistoric times. In 1977 she wrote a book on the subject, *Prêhistoire du feu*. An associate professor in the Department of Ethnology at the University of Paris at Nanterre, Perlès has done archeological fieldwork in both France and Greece. Her interests include stone-tool technology, prehistoric food processing, and the importance of diet changes in human evolutionary development.





Amanda Mayer Stinchecum's acquaintance with traditional Japanese attitudes and customs concerning how to keep warm stems from her experiences while living and traveling in Japan, as well as from her studies of Japanese art and literature. In particular, she has a longstanding interest in clothing and hand-produced textiles and in the relation between dress and forms of society. Holder of a Ph.D. in Japanese and comparative literature from Columbia University, Stinchecum is a free-lance journalist and museum consultant. She is now in Japan on a grant from New York's Metropolitan Museum of Art to research a book on Japanese "ikat" textiles—textiles in which the yarns are partly dyed according to a planned pattern before being woven.

© 1980 JULIUS WILE SONS & CO. IMPORTED FROM FRANCE 80 PROOF



A desire to explore the adaptations of animals to stressful environments has led **Cynthia Carey** to study quail in the California desert, toads in the high Rockies, and finches in the cold Michigan winter. Her present-day research includes the physiological and morphological adaptations of bird eggs to high altitudes. Carey is an assistant professor in the Department of Environmental, Population, and Organismic Biology at the University of Colorado.

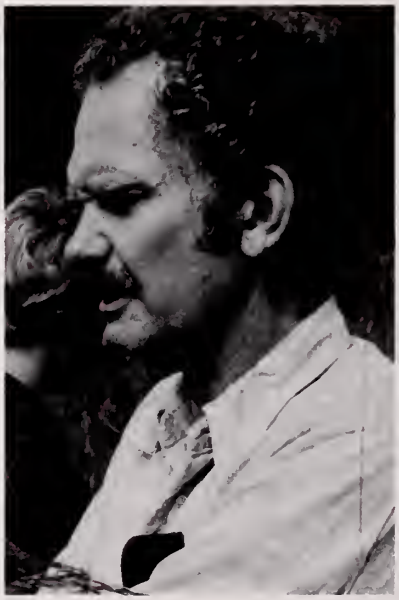
Like coauthor Carey, **Richard L. Marsh** began to study birds' metabolic adaptations to cold climates while he was a graduate student at the University of Michigan. The project he worked on allowed him to "combine an interest in biochemistry with interests in adaptations of birds to their environments." Now a postdoctoral scholar at the University of California, Irvine, Marsh is continuing his research on muscle physiology and temperature regulation in birds and reptiles.





Lynn Rogers has been monitoring the life styles of black bears in northeastern Minnesota since 1969. A wildlife research biologist at the North Central Forest Experiment Station of the U.S.D.A. Forest Service in Saint Paul, he has paid particular attention to the behavior and the habitat requirements of the bears. Rogers is known as a zealot when it comes to bears. He thinks nothing of crawling into a hibernating bear's den and measuring the animal's heart beat by laying his head on its chest. He is also expert with the rectal thermometer. Such talents have led to more than one interesting moment, but he is as yet unscathed, albeit looking more bearlike every year.

Roger M. Knutson's observations of solar heating in plants were made over a period of years as he taught a course that took him and his students out among the spring flora of northeastern Iowa. A professor of biology at Luther College in Decorah, Iowa, Knutson is also studying the primary productivity of annual herbs, such as giant ragweed and nettle, that grow on flood plains. In an earlier article for *Natural History* ("Plants in Heat," March 1979), Knutson described his investigations into the regulation of heat production in eastern skunk cabbage.





William Dwight Billings first worked on the physiological ecology of high-mountain plants more than forty years ago in the Sierra Nevada. Since then, his research has taken him to mountains throughout the world—in Hawaii, New Zealand, Australia, and Lapland, and along the Rocky Mountains and the Andes from the Arctic to the Equator. Billings is James B. Duke Professor of Botany at Duke University, where he is currently studying the effects of increasing temperatures on the exchange of carbon dioxide among plants, soils, and microorganisms in tundra ecosystems.

hexa·photo·cybernetic

The Possibilities are Endless.



Stopped-Down: 90

Six-mode exposure control. System versatility. Newer electronics for wider applications.



The Canon A-1 is one of the world's most advanced automatic SLR cameras. Combining the finest in optical and mechanical engineering with the most sophisticated electronics, it's technology applied to give you the ultimate in creative control. At the touch of a button.

Depending on your subject, you can choose from six independent exposure modes to achieve the results you want:

1 Shutter-Priority: You select the shutter speed, to freeze the action and prevent camera shake or create an intentional blur. The A-1 automatically selects the appropriate lens opening.

2 Aperture-Priority: Control the area in focus by selecting the lens opening for the effect you want. The A-1 matches with the right speed.

3 Programmed: When you need to shoot fast, just focus. The A-1 will select *both speed and aperture* for great results.

4 Stopped-Down: For extreme close-up or specialized photography, a bellows, a microscope or almost anything can be attached to the A-1. It's still automatic.

5 Flash: Totally automatic flash photography, of course, with a wide variety of Canon Speedlites to choose from.

6 Manual: Yes. For those times when you absolutely want to do it all yourself. To experiment. To explore the possibilities.



There are over forty fine Canon lenses ranging from Fish Eye to Super Telephoto, plus accessories to meet every need. If you can't photograph your subject with a Canon A-1, it probably can't be photographed.

From the sophistication of its LED viewfinder display, to a ruggedness that allows up to five-frame-per-second motor drive, the Canon A-1 represents an incredible technology. At a price that makes owning one a definite possibility.



Canon® A-1

Canon USA, Inc., One Canon Plaza, Lake Success, New York 11042 • 140 Industrial Drive, Elmhurst, Illinois 60126 • 6380 Peachtree Industrial Blvd., Norcross, Georgia 30071 • 123 Paularino Avenue East, Costa Mesa, California 92626 • Bldg. B-2, 1050 Ala Moana Blvd., Honolulu, Hawaii 96814 • Canon Optics & Business Machines Canada, Ltd., Ontario

© 1980 Canon U.S.A., Inc.

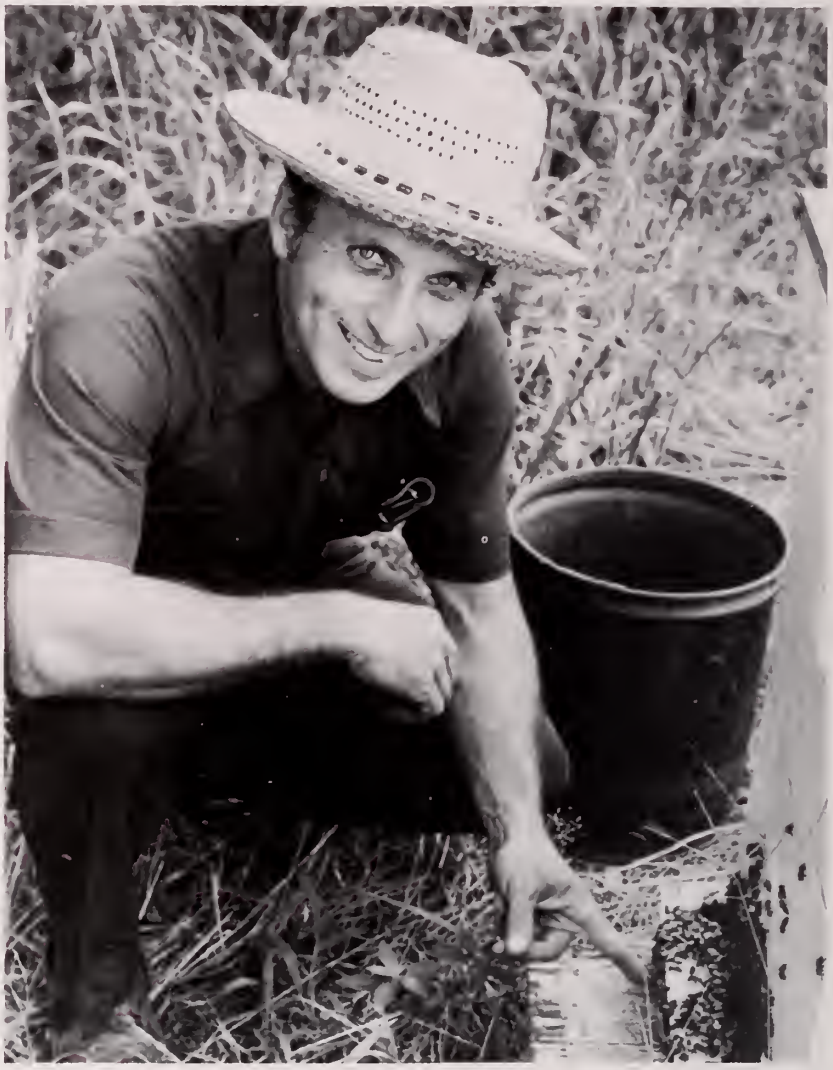


John V. E. Hansen is in charge of clothing, equipment, and materials research at the U.S. Army Natick Research and Development Laboratories in Natick, Massachusetts. The laboratory develops clothing and protective items that enhance the capability of U.S. soldiers to operate in all kinds of environments around the world. Hansen has a bachelor's degree in chemical engineering and has done graduate work in business administration. During the past nine years his duties have taken him from "Alaska to Arabia and from Ghana to Sweden."



Jane C. Nylander, curator of textiles and ceramics at Old Sturbridge Village, Massachusetts, has been reading early New Englanders' diaries and letters for fifteen years. From these and other literary sources she has gained a knowledge of the past that enhances the accuracy of historic house restoration and interpretation. A graduate of Brown University and the University of Delaware, Nylander is at present researching the textiles of eighteenth- and nineteenth-century New England.

A meteorologist by profession, with a Sc.D. in the subject **Edwin Kessler** is a farmer, gardener, and apiarist in his free time. Director of the National Severe Storms Laboratory of the National Oceanic and Atmospheric Administration in Norman, Oklahoma, Kessler lives on a farm and commutes to work. His farm has cows, chickens, a garden, and an orchard. He also grows rice in a 734-square-foot paddy. "I have a nice view," Kessler says, "and in addition the night sky is dark and is excellent for star gazing."





Colin High was born in London and received his B.S. and Ph.D. in geography and earth science from the University of Bristol. He moved permanently to the United States in 1973 because, he says, "it's nice here." He is now an associate professor of engineering and environmental studies at the Resource Policy Center of the Thayer School of Engineering at Dartmouth College. The center conducts research on the public and private use of such natural resources as forests, water, and energy. High's house in New Hampshire is heated exclusively with wood. It does not have a fireplace but does have an efficient wood-burning stove.

Sculptured . . . hand-painted . . . the first issue in what may become one of the best-loved plate collections of the '80s.

Making Friends

by Debbie Bell Jarratt

The *first* of the "Cobblestone Kids"™ —charming children of Colonial America presented in the tradition of portraying children on sculptured porcelain plates.

Hand-painted: Just $55.
Limited Edition.



SHOWN SMALLER THAN ACTUAL SIZE OF 7-1/2" IN DIAMETER

Advance subscription deadline: October 31, 1981.

Sculptured, hand-painted plates of fine porcelain have become a collecting tradition, mainly because of the Hummel series from Germany which portrays the children of the Alps at play.

Now to honor our own *American* children, Franklin Porcelain, America's foremost creator of collector plates, has created our *own* new series of collector plates, "The Cobblestone Kids." And we are pleased to announce the *very first* issue.

She's *Making Friends*. And she's charming. She's patting the cute little bunnies who hungrily eye the nice fat carrots she carries in her basket. Her rosy complexion and adorable golden curls make her one of the most delightful young ladies you're likely to meet anywhere. And you'll find her *only* on this beautiful new porcelain plate designed exclusively for Franklin Porcelain by Debbie Bell Jarratt, an artist with extraordinary ability to capture all the wonder and innocence of a child's world.

To further enhance this delightful plate, *Making Friends* is being crafted in *three dimensions*, with the design *sculptured* in all its rich detail, then *hand-painted* in 13 different colors, so that each plate is a completely separate and unique work of art. And despite the fact that new issues of Hummel plates are selling today for approximately $100, you may enter your order for *Making Friends* at the unusually attractive price of just $55, payable in two monthly installments of $27.50 each.

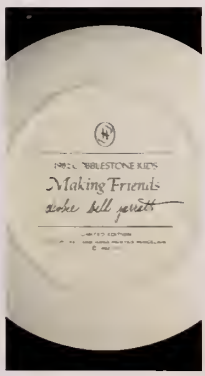
The all-important first issue—available only from Franklin Porcelain

In the established tradition of outstanding plates in fine porcelain, *Making Friends* will be made available in a limited edition, reserved exclusively for those who order from the collection of sculptuted porcelain plates before the end of 1982. The edition will then be permanently closed.

Significantly, too, *Making Friends* is the *first* issue in this important new series portraying the children of early America. And because it is the *first* in the series, it is the one likely to be most sought by collectors in the future.

Advance invitation valid only until October 31, 1981.

Making Friends will be created for Franklin Porcelain in Taiwan, home of some of the world's most talented porcelain craftsmen. No payment is required at this time. But to be sure of earliest shipment, you are urged to complete and return the Advance Order Form no later than October 31, 1981.



The backstamp of each plate (left) bears the name of the collection, the title of that individual plate, and the artist's signature.

OUR PLEDGE TO YOU: At Franklin Porcelain we take pride in our standards of design and craftsmanship. But we believe our efforts should be judged by the people we serve. You may therefore return *Making Friends* within 30 days, in its original condition, for your choice of replacement or refund.

© 1981 FP

ADVANCE ORDER FORM

Making Friends

Valid only until October 31, 1981.
Limit: One plate per collector.

Franklin Porcelain
Franklin Center, Pennsylvania 19091

Please enter my order for *Making Friends*, to be sculptured and hand-painted for me in fine porcelain. I need send no money at this time. I will be billed in two monthly payments of $27.50* for the plate, the first payment due prior to shipment.

*Plus my state sales tax

Signature _____
ALL ORDERS ARE SUBJECT TO ACCEPTANCE

Mr. Mrs. Miss _____
PLEASE PRINT CLEARLY

Address _____

City _____

State _____ Zip _____

A Visit to Dayton

The site remains a pleasant, sleepy town, but the bestial cause of the Scopes trial stirs again

by Stephen Jay Gould

In his summation to the court, Clarence Darrow talked for three full days to save the lives of Nathan Leopold and Richard Loeb. Guilty they clearly were, of perhaps the most brutal and senseless murder of the 1920s. By arguing that they were victims of their upbringing, Darrow sought only to mitigate their personal responsibility and substitute a lifetime in jail for the noose. He won, as he usually did.

John Thomas Scopes, defendant in Darrow's next famous case, recalled his attorney's theory of human behavior in the opening lines of an autobiography published long after the famous "monkey trial" (*Center of the Storm*, Holt, Rinehart and Winston, 1967). "Clarence Darrow spent his life arguing—teaching, really—that a man is the sum of his heredity and his environment." The world may seem capricious, but events have their reasons, however complex. These reasons conspire to drive events forward; Leopold and Loeb were not free agents when they bludgeoned Bobby Franks and stuffed his body into a culvert, all to test the idea that a perfect crime might be committed by men of sufficient intelligence.

We wish to find reasons for the manifest senselessness that surrounds us. But deterministic theories, such as Darrow's, leave out the genuine randomness of our world, a chanciness that gives meaning to the old concept of human free will. Many events, although they move forward with accelerating inevitability after their inception, begin as a concatenation of staggering improbabilities. And so we all began, as one sperm among billions vying for entry; a microsecond later, I might have been the Stephanie my mother wanted.

The Scopes trial in Dayton, Tennessee, occurred as the outcome of accumulated improbability. The Butler Act, passed by the Tennessee legislature and signed by Gov. Austin Peay on March 21, 1925, declared it "unlawful for any teacher in any of the Universities, Normals and all other public schools of the state—which are supported in whole or in part by the public school funds of the State, to teach any theory that denies the story of the Divine Creation of man as taught in the Bible, and to teach instead that man has descended from a lower order of animals." The bill could have been beaten with little trouble had the opposition bothered to organize and lobby (as they had the previous year in Kentucky, when a similar bill in similar circumstances went down to easy defeat). The senate passed it with no enthusiasm, assuming a gubernatorial veto. One member said of Mr. Butler: "The gentleman from Macon wanted a bill passed; he had not had much during the session and this did not amount to a row of pins; let him have it." But Peay, admitting the bill's absurdity and protesting that the legislature should have saved him from embarrassment by defeating it, signed the act as an innocuous statement of Christian principles: "After a careful examination," wrote Peay, "I can find nothing of consequence in the books now being taught in our schools with which this bill will interfere in the slightest manner. Therefore it will not put our teachers in any jeopardy. Probably the law will never be applied. . . . Nobody believes that it is going to be an active statute." (See Ray Ginger's *Six Days or Forever?* Beacon Press, 1958, reprinted in paperback by Oxford University Press, 1974, for a fine account of the legislative debate.)

If the bill itself was improbable, Scopes's test of it was even more unlikely. The American Civil Liberties Union (ACLU) offered to supply council and provide legal costs for any teacher willing to challenge the act by courting an arrest for teaching evolution. The test was set for the favorable urban setting of Chattanooga, but plans fell through. Scopes didn't even teach biology in the small, inappropriate, fundamentalist town of Dayton, located forty miles north of Chattanooga. He had been hired as an athletic coach and physics teacher but had substituted in biology when the regular instructor (and principal of the school) fell ill. He had not actively taught evolution at all, but merely assigned the offending textbook pages as part of a review for an exam. When some town boosters decided that a test of the Butler Act might put Dayton on the map—none showed much interest in the intellectual issues—Scopes was available only by another quirk of fate. (They would not have asked the principal, an older, conservative family man, but they suspected that Scopes, a bachelor and free thinker, might go along.) The school year was over, and Scopes had intended to depart immediately for a summer with his family. But he stayed on because he had a date with "a beautiful blonde" at a forthcoming church social.

Scopes was playing tennis on a warm afternoon in May, when a small boy appeared with a message from "Doc" Robinson, the local pharmacist and owner of Dayton's social center, Robinsons' Drug Store. Scopes finished his game, for there is no urgency in Dayton, and then ambled on down to Robinsons',

Send for your
FREE ANIMAL BOOK
right now!



Just drop this card in the mail today. You will receive a magnificent new ZOOBOOK® **free of charge**—as your special introduction to this wonderful new series of animal books. A one-year trial subscription to ZOOBOOKS® will also be entered in your name . . . to give you the right to acquire future books in the series **for only $1 each.**

If you're not completely delighted with the free book, just cancel the trial subscription and **you owe nothing.** The free book is yours to keep with our compliments.

NAME _____
(Please print clearly)

ADDRESS _____

CITY _____

STATE _____ **ZIP** _____

2005

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO. 11369 SAN DIEGO, CA

POSTAGE WILL BE PAID BY ADDRESSEE

ZOOBOOKS®
Wildlife Education, Ltd.
930 West Washington Street
San Diego, CA 92103



To introduce you to a unique new series of animal books for children, we'd like to give you a

FREE BOOK.

These new animal books are so beautiful and informative that you must see them for yourself to fully appreciate them! That's why we want to send you the first book in the series *free of charge* . . .

As you (and your children) turn the pages of your free book, we think you'll be astonished by the sheer wealth of fascinating facts—and the beautiful way in which they are presented. Page after page, you'll see some of the finest animal photographs ever taken. You'll enjoy wonderful paintings especially created for ZOOBOOKS® by some of the finest nature artists in the world. And most important, you'll see for yourself how your children will love these books!

When you've finished looking over the free book, it's very likely that you will want your children to have further books in the ZOOBOOKS® series—and that's why we've devised a special arrangement that will make it possible for you to acquire these books **for only $1 per book.**

When we send your free book to you, we will also enter a special one-year trial subscription to ZOOBOOKS® in your name. You will then be eligible to receive 12 magazine-size books (8½″ × 11″) for only $12—a different book every month for 12 months. **This does not obligate you in any way.** If you are not completely satisfied with the sample book, simply cancel the subscription *and you owe nothing*. The free book is yours to keep, either way.



GORGEOUS ORIGINAL ILLUSTRATIONS

EXCITING NEW WAYS TO LEARN.





SCIENTIFIC FACTS MADE EASY.

PRINTED IN BEAUTIFUL COLOR.



The free book you will receive** is a superb introduction to the Great Apes (gorillas, chimpanzees, and orangutans) and the Lesser Apes (gibbons and siamangs). It's packed with striking photos and paintings showing how apes live, and an easy-to-read text tells why these incredible animals behave as they do. It's a stunningly beautiful book—**and it's yours without obligation of any kind!

OTHER BOOKS YOU WILL BE ELIGIBLE TO RECEIVE IN THE FUTURE (AS PART OF A SUBSCRIPTION) INCLUDE BIG CATS, BIRDS OF PREY, ELEPHANTS, BABY ANIMALS, SNAKES, BEARS, WILD HORSES, WHALES, AND ENDANGERED SPECIES.

2005

Mail this coupon to
Zoobooks, 930 West Washington Street, San Diego, California 92103

Please send me the FREE BOOK and enter a trial 1-year subscription to ZOOBOOKS®. I understand that I may cancel the subscription if I want, after seeing the free book, and owe nothing.

NAME _____

ADDRESS _____

CITY _____

STATE _____ ZIP _____

If bind-in card is missing, please use this coupon to send for your FREE BOOK.

Photographs by Deborah L. Gould



The Scopes trial was planned in Robinsons' Drug Store, which moved to its present location in 1928.

where he found Dayton's leading citizens crowded around a table, sipping Coke and arguing about the Butler Act. Within a few minutes, Scopes had offered himself as the sacrificial lamb. From that point, events accelerated and began to run along a predictable track. William Jennings Bryan, who had stirred millions with his "Cross of Gold" speech and almost become president as a result, was passing his declining years as a fundamentalist stumper—"a tinpot pope in the Coca-Cola belt," as H.L. Mencken remarked. He volunteered his services for the prosecution, and Clarence Darrow responded in kind for the defense. The rest, as they say, is history. Of late, it has, alas, become current events as well.

Robinsons' Drug Store is still the social center of Dayton, although it moved in 1928 to its present location in the shadow of the Rhea County courthouse, where Scopes faced the wrath of Bryan's God. "Sonny" Robinson, Doc's boy, has run the store for decades, dispensing pills to the local citizenry and thoughts about Dayton's moment of fame to the pilgrims and gawkers who stop by to see where it all started. The little round table, with its wire-backed chairs, occupies a central place, as it did when Scopes, Doc Robinson, and George Rappelyea (who made the formal "arrest") laid their plans in May 1925. The walls are covered with pictures and other memorabilia, including Sonny Robinson's only personal memory of the trial: a photograph of a five-year old boy, sitting in a carriage and pouting because a chimpanzee had received the Coke he had expected. (The chimp was a prominent member in the motley entourage of camp followers, many of comparable intelligence, that descended upon Dayton during the trial, in search of ready cash rather than eternal enlightenment.)

I was visiting Robinsons' Drug Store in June, when a San Francisco paper called with a request for photos of present-day Dayton. Sonny Robinson, who claims to be a shy man, began a flurry of calls to exploit the moment. Up north in the big town, you wouldn't keep a man waiting, at least not without a request or an explanation: "Excuse me, I know you must be in a hurry, but would you mind, it won't be more than a few minutes. . . ." But it was 97° outside and cool in Sonny Robinson's store. And where would a man be going anyway? Half an hour later, his personages assembled, Sonny Robinson pulled out the famous table and brought three Cokes in some old-fashioned 5¢ glasses. I sat in the middle ("the biology professor from Harvard who just happened to walk in," as Robinson had told his callers). On one side sat Ted Mercer, president of Bryan College, the fundamentalist school begun as a legacy to the "Great Commoner's" last battle. On the other side sat Mr. Robinson, son of the man who had started it all around the same table fifty-six years before. The fundamentalist editor of the Dayton *Herald* snapped our pictures and we sipped our Cokes.

Dayton has remained a small and inconspicuous town. If you're coming from Knoxville via Decatur, you still have to cross the Tennessee River on a six-car ferry. The older houses are well kept, with four white pillars in front, the vernacular imitation of plantation style. (As a regional marker of the South, these pillars are architecture's equivalent of the dependable gastronomical



IF you order a full set of Laurie Auchterlonie's clubs, you can expect him to make them with hickory, applewood, ram's horn and his hands. But don't expect them until 1987.



There are three people ahead of you.

The good things in life stay that way.
Dewar's® never varies.

Authentic.
The Dewar Highlander

BLENDED SCOTCH WHISKY • 86.8 PROOF
© 1981 SCHENLEY IMPORTS CO., N.Y., N.Y.





Scarlet Ibis 1978

Announcing publication of
Raymond Ching's
STUDIES AND SKETCHES
OF A BIRD PAINTER

a leather-bound, boxed edition limited to 500 signed and numbered volumes. Over 100 plates—40 in full color—show Ching's unique genius in works of rare beauty and ornithological accuracy. A valuable addition to the study of natural history and bird art! **11 x 16" 288 pages $575.00**

(trade edition distributed by Harry N. Abrams, Inc.)

For brochure write to:

LANSDOWNE EDITIONS

420 Madison Avenue, New York, N.Y. 10017

From the publisher of PARROTS OF THE WORLD and AUSTRALIAN PARROTS.

criterion: when the beverage simply labeled "tea" on the menu invariably comes iced.) H. L. Mencken, not known for words of praise, confessed (in surprise) his liking for Dayton:

> I had expected to find a squalid Southern village . . . with pigs rooting under the houses and the inhabitants full of hookworm and malaria. What I found was a country town full of charm and even beauty. . . .The houses are surrounded by pretty gardens, with cool green lawns and stately trees. . . . The stores carry good stocks and have a metropolitan air, especially the drug, book, magazine, sporting goods and soda-water emporium of the estimable Robinson.

Some things have changed, of course. Trailers now rooted to their turf and houses of undressed concrete block reflect the doubling of Dayton's population to nearly 4,000. The older certainties may have eroded somewhat. A banner headline in this week's Dayton *Herald* tells of a $200-million marijuana crop confiscated and destroyed in Rhea and neighboring Bledsoe counties. And a quarter gets you a condom—"sold for the prevention of disease only," of course—at vending machines in restrooms of local service stations. At least they can't blame evolution for this, as one evangelical minister did a few months back when he cited Darwin as primary supporter of the four "p's": prostitution, perversion, pornography, and permissiveness. They taught creationism in Dayton before John Scopes arrived, and they teach it today.

For all these muted changes, Dayton remains a two-street town, dwarfed at the crossroad by the Rhea County courthouse, a Renaissance Revival building of the 1890s seemingly too large by half for a small town in a small county. Yet even this courtroom failed in its moment of glory, as Judge Raulston, noting that the weight of humanity had opened cracks in the ceiling below, reconvened his court on the side lawn, where Darrow grilled Bryan alfresco. (It is a meaningless and tangential irony to be sure, but I thought I'd mention it: I don't know how Rhea County got its name. Rhea was the daughter of Uranus and the mother of Zeus. Her name also applies to the South American "ostrich." On the *Beagle* voyage, Darwin rediscovered a second species, the lesser, or Darwin's, rhea, living in a different part of South America. In one of his first evolutionary speculations, Darwin surmised that the spatial difference between these two rheas might be analogous to the temporal distinction between extinct species and their living relatives.)

The Scopes trial is surrounded by misconceptions, and their exposure provides as good a way as any for recounting the basic story. In the heroic version, John Scopes was persecuted, Darrow rose to Scopes's defense and smote the antediluvian Bryan, and the antievolution movement then dwindled or ground to at least a temporary halt. All three parts of this story are false.

For the first, we have already noted that Austin Peay and the legislators of Tennessee did not intend to enforce their law. In fact, Bryan himself had lobbied the legislature (unsuccessfully) with advice that the act prescribe no penalty at all for noncompliance. It was, after all, only a symbolic statement; any teeth in the act might lead to its upset on constitutional grounds. The ACLU advertised in Tennessee papers for a test case. George Rappelyea read their offer in the Chattanooga *Times* and moseyed on down to Robinsons' with his plan. Later, John Scopes remembered: "It was just a drugstore discussion that got past control." For once, the tale of outside (even Yankee) agitators tells at least a half-truth.

Bryan was vanquished and embarrassed during the trial, but not primarily by Darrow. The trial itself, with its foregone conclusion, was something of a bore. (Scopes *had* violated the law and the defense wanted a quick conviction for an advantageous move to a higher court.) It dragged on in interminable legal wrangling and had only two moments of high drama. The first occurred during a legal argument about the admissibility of expert testimony. The defense had brought to Dayton an impressive array of men prominent both in evolutionary biology and Christian conviction. The prosecution urged that their testimony be excluded. The law plainly forbade the teaching of human evolution, and Scopes just as plainly had violated the law. The potential truth of evolution was not an issue. Judge Raulston agreed with the prosecution, and the assembled experts took to their typewriters instead. With benefit of a weekend recess to hone their statements, the experts produced some formidable documents. They were printed in newspapers throughout the country, and Judge Raulston finally did admit them into the printed record of the trial.

Bryan, who had sat in uncharacteristic silence for several days, used this procedural argument as a springboard for his prepared excoriation of evolu-

tion. In a grandiloquent speech clearly directed to his constituents (witnesses remarked that he stood with his back to the judge), Bryan virtually denied that humans were mammals and argued that the case of Messrs. Leopold and Loeb amply demonstrated that too much learning is a dangerous thing. The defense's rebuttal provided Bryan's first humiliation; for in this rural land, before the advent of television, no art commanded more respect than pure speechifying. And Bryan was just plain outspoken, outgestured, and outshouted—not by Darrow—but by another defense attorney, Dudley Field Malone, a prominent New York divorce lawyer and former subordinate to Bryan in the State Department (where Bryan had been secretary under Woodrow Wilson). H.L. Mencken wrote:

> I doubt that any louder speech has ever been heard in a court of law since the days of Gog and Magog. It roared out of the open windows like the sound of artillery practice, and alarmed the moonshiners and catamounts on distant peaks. . . . In brief, Malone was in good voice. It was a great day for Ireland. And for the defense. For Malone not only out-yelled Bryan, he also plainly out-generaled and out-argued him. . . . It conquered even the fundamentalists. At its end they gave it a tremendous cheer—a cheer at least four times as hearty as that given to Bryan. For these rustics delight in speechifying, and know when it is good. The devil's logic cannot fetch them, but they are not above taking a voluptuous pleasure in his lascivious phrases.

Nonetheless, Judge Raulston ruled against the defense and excluded expert testimony the next morning. It was Friday and all seemed over, including the shouting. Scopes would be convicted summarily on Monday morning; he had violated the law and Raulston's narrow construction of the case had excluded all other issues. Virtually all the journalists, including H.L. Mencken, left town to avoid both the lull of a weekend recess and the expected anticlimax to follow. Thus, when Darrow induced Bryan to take the stand as an expert witness on the Bible, he spoke to a depleted local crowd and a skeleton crew of journalists. The reconstruction of *Inherit the Wind* and other accounts dramatize what was only an afterthought.

It is not even clear why Raulston allowed Bryan to appear (since he had excluded experts of opposite persuasion). The other prosecuting attorneys tried to dissuade Bryan, and Raulston finally expunged the entire exchange from the record. Bryan viewed the occasion as a desperate attempt to recover from Malone's drubbing, but Darrow exposed him as a pompous fool. Still, the most famous moment of the exchange—when Bryan deserted strict fundamentalist tenets by admitting that the days of Genesis might have lasted far longer than twenty-four hours—was not, as legend has it, a reluctant admission drawn forth by Darrow's ruthless logic. Bryan offered this statement freely, as an initial response to a series of questions. He did not seem to appreciate that local fundamentalists would regard it as a betrayal, and the surrounding world as a fatal inconsistency.

Scopes's conviction was eventually quashed on a technicality. Judge Raulston had set the fine of $100 himself, but Tennessee law stated that all fines greater than $50 had to be recommended by the jury. With Bryan humiliated and the conviction quashed, the legend of victory for the defense arose, thus completing the heroic version. But the Scopes trial was a defeat (or a victory so Pyrrhic that it scarcely deserves the name) for several reasons. First, Bryan recouped by involuntarily taking the only option left for an imme-



...And suddenly it was as though I was next to him. I could make out every detail with incredible clarity and brilliance; the moist eyes, each feather stood out in startling detail. It was a moment I would never forget. I was glad I chose Nikons."

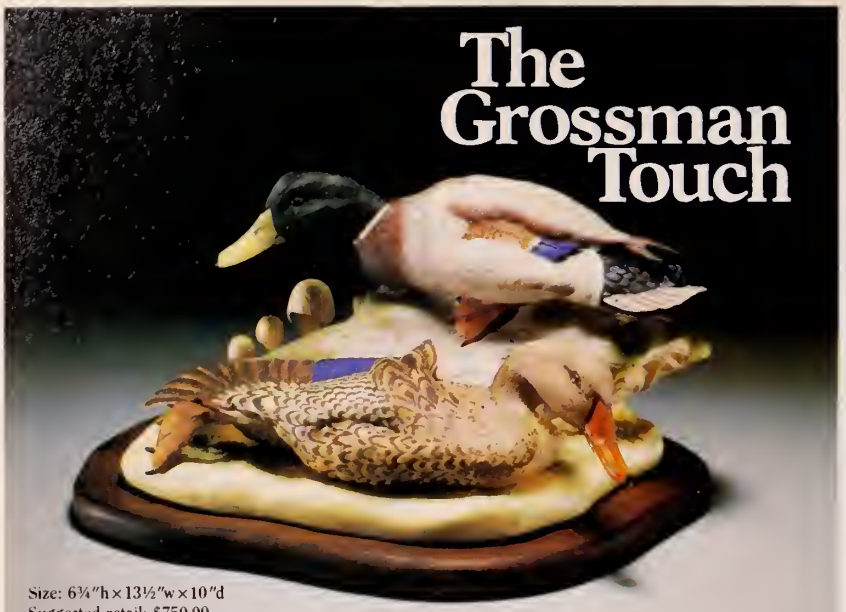
It's moments like these that make you glad you didn't settle for anything less than Nikon Binoculars. Their superb optics and uncompromising prism-lock construction are designed to give years of flawless performance even under the toughest conditions.

There are more than 20 Nikon Binoculars to choose from. See them at your Nikon dealer or write Nikon Inc., Dept. 26, 623 Stewart Ave., Garden City, N.Y. 11530.

NIKON 9X35 E SERIES ROOF PRISM BINOCULARS

Nikon

©1981 NIKON INC.



Size: 6¾"h × 13½"w × 10"d
Suggested retail: $750.00

The delicacy of handmade porcelain, entirely handpainted to capture every nuance of nature's majestic beauty—this is the Grossman Touch. The Mallard Pair, skillfully modeled by Dr. William Turner, one of America's premier wildlife artists, is one piece in the collection of more than 20 sculptures produced in limited editions by the artisans of D.G. Porcelains of Virginia. See this collection today at the dealer nearest you. Or send five dollars for a full-color brochure.

The Dave Grossman Designs Touch—creating collectibles that are innovative, authentic and worthy of your taste.

Dave Grossman Designs, Inc.
Dept. 106 P.O. Box 8482
St. Louis, MO 63132

Made in America

DGD 1981



Australia is unlike any other place on earth. You can walk back into time and leap into the future. All in the same day.

Join a rugged safari tour. Experience spectaculars like the vast Outback. The Great Barrier Reef. Living deserts and tropical rain forests.

Go game fishing, mountain climbing, camel-trekking. Ride around a sheep station. Pan for gold. Or hop off the trail and explore one of our cosmopolitan cities.

Send for our free Travel Planner. And take a tour of our continent before you come, mates.

See your Travel Agent or mail this coupon for your free Travel Planner.

Australian Tourist Commission
Distribution Center, P.O. Box A-1,
Dept. 151B-013, Addison, IL 60101

My special interest is _____

Name _____

Address _____

City _____ State _____ Zip _____

diate restoration of prestige: he died in Dayton a week after the trial ended. Ted Mercer's Bryan College, a thriving fundamentalist institution in Dayton, is his local legacy. Second, the quashing of Scopes's conviction was a bitter pill for the defense. Suddenly, there was no case left to appeal. All that effort down the tubes of a judge's $50 error.

The Butler Act remained on the books until its repeal in 1967. It was not enforced, but who can tell how many teachers muted or suppressed their views and how many children never learned one of the two or three most exciting and expansive ideas ever developed by scientists. In 1973, a "Genesis Bill" passed the senate of Tennessee 69 to 16. It legislated equal time for evolution and creation and required a disclaimer in all texts that any stated idea about "the origin and creation of man and his world . . . is not represented to be scientific fact." The Bible, however, was declared a reference work, not a text, and therefore exempt from the requirement for a printed disclaimer. This bill was declared unconstitutional a few years later.

Third, and sadly, any hopes that the issues of Scopes's trial had been banished to the region of nostalgic Americana have been swept aside by our current creationist resurgence—the climate that inspired my detour across the Tennessee River in June.

Late in his life, I came to know Kirtley Mather, emeritus professor of geology at Harvard, pillar of the Baptist church, lonely defender of academic freedom during the worst days of McCarthyism, and perhaps the finest man I have ever known. Kirtley was also a defense witness in Dayton. Each year, from the late 1960s to the mid 1970s, Kirtley gave a lecture to my class recalling his experiences at Dayton. It seemed a wonderful echo of times gone by, for Kirtley, in his late eighties, could still weave circles around the finest orators at Harvard. The lecture didn't change much from year to year. I viewed it first as a charming evocation, later as mildly related to current affairs, finally as a vital statement of pressing realities. This year, I will dust off the videotape and show it to my class as a disquisition on immediate dangers.

In 1965, John Scopes permitted himself this hope in retrospect:

> I believe that the Dayton trial marked the beginning of the decline of fundamentalism. . . . I feel that restrictive legislation on academic freedom is forever a thing of the

past, that religion and science may now address one another in an atmosphere of mutual respect and of a common quest for truth. I like to think that the Dayton trial had some part in bringing to birth this new era.

(Scopes, by the way, later went to the University of Chicago and became a geologist. He lived quietly in Shreveport, Louisiana, for most of his life, working, as do so many geologists, for the petroleum industry. This splendid man of quiet integrity refused to capitalize on his transient and accidental fame in any way. His silence betokened no crisis of confidence or any departure from the principles that led to his momentary renown. He simply chose to make his own way on his own merits.)

In 1981, Jerry Falwell has donned Bryan's mantle, and Scopes's hopes for a "new era" have been thwarted. Of course, we will not replay Scopes's drama in exactly the same way; we have advanced somewhere in fifty-six years. Evolution is now too strong to exclude entirely, and current proposals for legislation (including bills already passed in Arkansas and Louisiana) mandate "equal time" for evolution and for old-time religion masquerading under the self-contradictory title of "scientific creationism." But the similarities between 1925 and 1981 are more disconcerting than the differences are comforting.

As in 1925, creationists are not battling for religion. They have been disowned by leading churchmen of all persuasions, for they debase religion even more than they misconstrue science. They are a motley collection to be sure, but their core of practical support lies with the evangelical right, and creationism is a mere stalking horse or subsidiary issue in a political program that would ban abortion, erase the political and social gains of women by reducing the vital concept of the family to an outmoded paternalism, and reinstitute all the jingoism and distrust of learning that prepares a nation for demagoguery.

As in 1925, they use the same methods of willful misquotation to impart a "scientific" patina to creationism. I am now a major victim of these efforts because my views on rapid evolutionary bursts followed by long periods of stasis can be distorted to apparent support for creation by fiat and unchanging persistence of immutable types. (I do, however, take some comfort in the fact that creationists of the last generation were equally skillful and devious in twisting to their own purposes the statements of strict gradualists.) I was therefore amused (or soothed) to read that, in 1925, Bryan and company were exploiting in the same manner the forthright address that William Bateson delivered to the American Association for the Advancement of Science in 1922. Bateson had expressed his confidence in the fact of evolution, but had honestly admitted that, despite reigning pomposity and textbook pap, we knew rather little about the mechanisms of evolutionary change. Scopes's prosecutors had cited Bateson as "proof" that scientists had admitted the tenuousness of evolution itself. In his written affidavit to Judge Raulston, W.C. Curtis, a zoologist from the University of Missouri, submitted a letter from Bateson:

> I have looked through my Toronto address again. I see nothing in it which can be construed as expressing doubt as to the main fact of evolution. . . . I took occasion to call the attention of my colleagues to the loose thinking and unproven assumptions which pass current as to the actual processes of evolution. We do know that the plants and animals, including most certainly man, have been evolved from other and very different forms of life. As to the nature of this process of evolution, we have many conjectures but little positive knowledge.

The Creative Alternative From Soligor



Our 35-70mm Zoom Lens

By replacing the "standard" lens that came with your camera with one that sees wider and longer, you'll put pizazz in your pictures. Which is why you should look into our creative alternative—the Soligor 35-70mm zoom lens.

Use it to zoom in and crop right in the camera to give your portraits added impact. Or, zoom out to make your subject part of a wider scene for added interest, and to get the whole group in when you can't step back. The 35-70 lets you widen your view, or bring your subjects up close, so you can shoot as you've never shot before. Best of all, a surprisingly low price makes this creative lens the affordable alternative.

If you'd like to add excitement and impact to your photography, visit your nearest dealer and try our creative alternative—the Soligor 35-70mm zoom lens—on your Canon, Minolta, Pentax, Olympus, Nikon or other fine 35mm SLR camera. Or, write for full information.

SOLIGOR®
MAKES THE DIFFERENCE

AIC Photo, Inc. Carle Place, N.Y. 11514
In Canada Kingsway Film Equipment Ltd. Ontario

Curtis also submitted a letter from Bryan's old boss Woodrow Wilson: "Of course, like every other man of intelligence and education, I do believe in organic evolution. It surprises me that at this late date such questions should be raised." Ronald Reagan, however, raised them on the stump before a fundamentalist crowd in Dallas.

I learned something in Dayton, or rather, remembered something I should never have forgotten, while sipping that 5¢ Coke around the original table in Robinsons' Drug Store. The enemy is not fundamentalism; it is intolerance. In this case, the intolerance is perverse since it masquerades under the "liberal" rhetoric of "equal time." But mistake it not. Creationists are trying to impose a specific religious view by legislative fiat upon teachers who reject it both by conscience and training. For all their talk about weighing both sides (a mere matter of political expediency), they would also substitute biblical authority for free scientific inquiry as a source of empirical knowledge.

All the commentators at Dayton, including the caustic H.L. Mencken himself, noted that the local people, although secure in their creationist beliefs, showed no intolerance or even discourtesy to the opposition. They feted Bryan when he arrived in town, and they provided a spread of equal size for Darrow. They applauded Malone on the merits of his speech. Mencken wrote:

> Nor is there any evidence in the town of that poisonous spirit which usually shows itself when Christian men gather to defend the great doctrine of their faith. I have heard absolutely no whisper that Scopes is in the pay of the Jesuits, or that the whisky trust is backing him, or that he is egged on by the Jews who manufacture lascivious moving pictures. On the contrary, the Evolutionists and the Anti-Evolutionists seem to be on the best of terms and it is hard in a group to distinguish one from the other.

Dayton has persevered in its geniality. I encountered warm disagreement with my evolutionary views, but I sensed no disrespect for my opinions and no inclination to demote me as a person because I disagreed with a favored belief. Geniality of this sort is widespread but, alas, so fragile. A few seeds of ugliness and intolerance can generate the cover

The twelve-day trial began inside Dayton's Rhea County courthouse but ended on a side lawn.



ORDER FORM

The American Horticultural Society
c/o The Franklin Library
Franklin Center, Pennsylvania 19091

Please send me *Houseplants,* Volume One of The Illustrated Encyclopedia of Gardening, absolutely FREE and without obligation. If you do not hear from me within 14 days, send me subsequent volumes for free examination at the rate of one every six weeks. Any I keep will be billed to me at $9.95* plus $1.45 postage, shipping and handling. There is no minimum number of books for me to purchase, and I am free to cancel my subscription at any time upon giving you thirty days' written notice.

Even if I decide not to continue with the Encyclopedia, *Houseplants* is mine to keep FREE.

Mail this Postpaid Card to Receive HOUSEPLANTS Absolutely Free

Please mail by October 31, 1981

Mr.
Mrs.
Miss _____
PLEASE PRINT CLEARLY

Address _____

City _____

State, Zip _____

**Plus my state sales tax*

Signature _____
ALL ORDERS ARE SUBJECT TO ACCEPTANCE

A

33

Natural History

1981 AHS

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

TG

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO 1 FRANKLIN CENTER, PENNSYLVANIA

POSTAGE WILL BE PAID BY ADDRESSEE

THE AMERICAN HORTICULTURAL SOCIETY
c/o The Franklin Library
Franklin Center, Pennsylvania 19063

B

The American Horticultural Society,
America's leading nonprofit center for gardening information,
invites you to

Take this illustrated, hardbound volume on Houseplants absolutely FREE

with no obligation to buy anything now or ever.

- **Practical information on over 400 different houseplants**
- **Show-how photographs, drawings and diagrams**
- **Step-by-step instructions on every phase of houseplant care**



Now, the experts of the American Horticultural Society will teach you what they've learned over the years about growing healthier and more beautiful houseplants. *And it won't cost you anything to find out.* Because the Society wants you to accept this large, hardbound, 144-page book on HOUSEPLANTS absolutely FREE—just to introduce you to their new Illustrated Encyclopedia of Gardening. But there's no obligation. You need never buy another book if you do not want to.

This authoritative volume gives you a *complete course* in houseplant care. You'll find out how to get the most out of the plants you now have. And when you want to pick a new one, there's a 9-page *Plant Selection Guide* to help you—listing 400 houseplants and how much light, water, humidity, etc., they need. Plus many illustrated charts, diagrams, drawings to show you how.

Now you can solve all your gardening problems

For more than 50 years, the American Horticultural Society has been helping gardeners solve their problems. Now they've put everything they know into this comprehensive Encyclopedia—all in straightforward, nontechnical language plus full-color photographs, step-by-step diagrams and special charts.

Each volume takes a single gardening subject and follows it through from beginning to end. FUNDAMENTALS OF GARDENING tells you what, when and how to plant for best results in *your* area of the country. ANNUALS gives you information on dozens of marigolds, 40 petunias, shows you colors, heights and best growing conditions for all your favorite annuals. ROSES includes a 14-page selection guide to help you choose the *right* roses, protect them in the winter, grow them indoors. PESTS AND DISEASES tells you the best way to control insects that attack your garden. VEGETABLES shows you how to *save money* by growing your family's favorites at a fraction of what they cost in the market.

And you'll learn about PERENNIALS, GROUND COVERS, LAWNS, PRUNING, BULBS and much more. So you'll have the most admired and healthiest garden in the neighborhood.

Start with your first volume Free

The American Horticultural Society is so sure these volumes will help solve your gardening problems that they will send you the first volume absolutely FREE. To obtain it, mail the attached card to The American Horticultural Society, c/o The Franklin Library, Franklin Center, Pa. 19091, which is producing the Encyclopedia for the Society. Please mail your card by October 31, 1981.





© 1981 AHS



Photographs and other memorabilia of the famous trial still cover the walls of Robinsons' Drug Store.

for an entire field. We have nothing to fear from the vast majority of fundamentalists who, like many citizens of Dayton, live by a doctrine that is legitimately indigenous to their area. Rather, we must combat the few yahoos who exploit the fruits of poor education for ready cash and larger political ends.

It was easy to dismiss Bryan because he was such a fool in his political dotage. Mencken wrote in his sharpest prose:

> Once he had one leg in the White House and the nation trembled under his roars. Now he is a tinpot pope in the Coca-Cola belt and a brother to the forlorn pastors who bclabor half-wits in galvanized iron tabernacles behind the railroad yards. . . . It is a tragedy, indeed, to begin life as a hero and to end it as a buffoon.

Many current creationists seem equally pitiable in their pronouncements: can anyone take seriously a link between Darwinism and the four evil p's?

But Mencken also understood the dangers, for he wrote in his final lines:

> Let no one mistake it for comedy, farcical though it may be in all its details. It serves notice on the country that Neanderthal man is organizing in these forlorn backwaters of the land, led by a fanatic, rid of sense and devoid of conscience. Tennessee, challenging him too timorously and too late, now sees its courts converted into camp meetings and its Bill of Rights made a mock of by its sworn officers of the law.

Do movements of intolerance ever start in any other way, given our pervasive tendencies toward geniality? Do they not always begin in comedy and end, when successful, in carnage? Who did not regard Hitler as an object of pitiful derision after the beer hall putsch. And who can read the famous words of Protestant theologian Martin Niemöeller without a shudder:

> First the Nazis went after the Jews, but I wasn't a Jew, so I did not react. Then they went after the Catholics, but I wasn't a Catholic, so I didn't object. Then they went after the workers, so I didn't stand up. Then they went after the Protestant clergy and by then it was too late for anybody to stand up.

Clarence Darrow understood the roots of intolerance only too well when he said in Dayton:

> If today you can take a thing like evolution and make it a crime to teach it in the public schools, tomorrow you can make it a crime to teach it in the private schools and next year you can make it a crime to teach it to the hustings or in the church. At the next session you may ban books and the newspapers. . . . Ignorance and fanaticism are ever busy and need feeding. Always feeding and gloating for more. Today it is the public school teachers; tomorrow the private. The next day the preachers and the lecturers, the magazines, the books, the newspapers. After a while, Your Honor, it is the setting of man against man and creed against creed until with flying banners and beating drums we are marching backward to the glorious ages of the sixteenth century when bigots lighted fagots to burn the men who dared to bring any intelligence and enlightenment and culture to the human mind.

Ever the cynic, H.L. Mencken evaluated this impassioned plea: "The net effect of Clarence Darrow's great speech yesterday seems to be precisely the same as if he had bawled it up a rainspout in the interior of Afghanistan." We had better proclaim the same message today into a downspout that resonates across the nation.

Stephen Jay Gould teaches biology, geology, and the history of science at Harvard University.

Old Bushmills.
It's changing people's minds about Irish Whiskey.



A blend of 100% Irish Whiskeys. 80 proof. Bottled in Ireland. The Jos. Garneau Co., New York, N.Y. ©1980

For free food and drink recipes, write to Old Bushmills, P.O. Box 639, New York, New York 10018. To send Old Bushmills anywhere in the country, call toll free: (800) 528-6148. Void where prohibited.

Experience the taste that experience created. Old Bushmills. Since 1608.



Vitruvius Teutsch, *Nürnberg, 1548*

THE SCIENCE–AND ART–OF

Keeping Warm

To survive the assaults of cold weather, the organisms that inhabit the earth rely on a wide variety of strategies: plants may drop their leaves; some animals fluff their feathers, while others hibernate; and human beings can choose to stoke the furnace, don a sweater, or even head for the nearest hot tub. This special issue of *Natural History* celebrates the diversity of ways in which life's battle against the cold is won.

Announcing...

The Ten Commandments
Plate Collection

- Important and beautiful original works of art by the distinguished artist, Mary Mayo.
- Lavishly hand-decorated with 240 square inches of pure 24kt gold.
- More gold by far than on any previous Danbury Mint plate collection.



Plates shown smaller than actual size of 9¼" in diameter.

Never in Danbury Mint history has gold been lavished to such an extraordinary degree on collector plates! And never before have collector plates honored a subject of greater grandeur or with more artistic majesty!

Here is a collection unlike any you've ever seen — combining with breathtaking beauty *three* of the treasures of our Western civilization!

For here is *gold* — the king of precious metals, prized for its rarity and universal value.

Here, too, is magnificent *original art in the grand tradition of the "old masters"* — art reminiscent of the masterpieces which adorn the world's great cathedrals, museums and houses of worship.

Finally, here is a majestic tribute to the foundation stone of our great religions and of our civilization itself — *The Ten Commandments*, plus two additional plates in honor of the two greatest teachers of those commandments, Moses and Jesus. (The Moses plate is shown at the bottom of this page.)

In all, the collection is a treasure that belongs in every home, *but only a fortunate few will have the opportunity to possess it!*

Hand-Decorated with a Lavish Border of 24kt Gold!

Each of these twelve collector plates will be richly hand-decorated with gleaming 24kt gold — more gold by far than any other plate collection in the history of the Danbury Mint!

From Biblical times to the present day, gold has been one of mankind's most treasured possessions and the ultimate standard of wealth. It is so prized because it is extraordinarily *beautiful* and exceedingly *rare*. Indeed, it is so scarce that all the gold mined since the beginning of time could fit into a single large room!

What's more, gold is *permanent* — it doesn't tarnish, corrode or deteriorate. A gold coin minted in the days when Moses received The Commandments would gleam as brightly today as it did then. Thus gold is known as the *eternal* metal, the medium artists and craftsmen throughout the ages have used to portray and honor the foremost figures and timeless doctrines of the world's great religions.

And now you can bring such golden artistic splendor into *your* home, where you can admire and enjoy it as often as you wish!

Original Works of Art in the Tradition of the Old Masters

For this exclusive private edition, the Danbury Mint has commissioned the distinguished artist, Mary Mayo, to create twelve original paintings expressly and exclusively for this collection.

As few other artists of our day, Mary Mayo has mastered her craft after years of studying the styles and techniques of the "old masters" — giants of classical art such as Rembrandt, Michelangelo and Raphael. Her canvases inspire a profound respect and admiration for such classic, timeless beauty!

Old World Craftsmanship Involving an Intricate Process

Like the original works of art, the production process to make these plates will respect time-honored traditions, employing the most expensive materials, highest standards of excellence, and patient hand-craftsmanship at every stage.

The plates will undergo a painstaking process of *five separate firings*: one to bake the china . . . a second to glaze it . . . a third to bond the radiant colors of the original art . . . a fourth to apply the beautiful "Old English" lettering along the rim identifying each plate . . . and, finally, a fifth to seal the luxurious gold border, which a skilled artisan has lavishly hand-painted onto each plate using a brush dipped in *pure liquid gold!*

A five firing process is exceptionally *rare* in the production of fine collector plates, and is a measure of the unsurpassed importance of this collection!



A Limited Edition Available only by Advance Reservation

The Ten Commandments Plate Collection will be available exclusively from the Danbury Mint. No plates will be sold separately and none will be made available in stores. The size of the U.S. edition will be forever limited to the exact number of collections reserved by the final deadline, December 31, 1981.

Convenient Acquisition Satisfaction Guaranteed

To reserve your *Ten Commandments Plate Collection*, simply complete the attached reservation application. There is no need to send payment now. Your twelve plates will be issued at the convenient rate of one every two months. You will be billed for each plate in two equal monthly payments of only $27.50 each.

If you receive any plate you are not completely satisfied with, you may return it upon receipt for replacement or refund. And you may discontinue your subscription at any time.

Act Promptly to Avoid Disappointment

This is truly a unique chance to assemble your own private gallery of classical art, richly embellished with an unprecedented *240 square inches of pure, 24kt gold!* To avoid disappointment, return the attached reservation application today!

RESERVATION APPLICATION H57

The Ten Commandments
Plate Collection

The Danbury Mint
47 Richards Avenue
Norwalk, Conn. 06856

Must be postmarked by December 31, 1981
Limit: One set per subscriber

Please accept my reservation application to **The Ten Commandments Plate Collection**. I understand this is a limited edition of twelve original works by artist Mary Mayo lavishly hand-decorated with 24kt gold.

I need send no money now. The collection will be issued at the rate of one plate every two months. I will pay for each plate as billed in two convenient monthly installments of $27.50 each. Any plate I am not completely satisfied with may be returned upon receipt for replacement or refund, and this subscription agreement may be cancelled by either party at any time.

Name _____

Address _____

City _____

State, Zip _____

☐ Check here if you want each monthly installment charged to your:
☐ Master Card ☐ VISA

Credit Card No. _____ Expiration Date _____

Signature _____
Allow 8 to 12 weeks after payment for initial shipment

Stonehenge Press in association with
THE AMERICAN MUSEUM
OF NATURAL HISTORY
invites you to...

GO DISCOVERING



Among the violent forces that shape the earth...



Explore undersea peaks, volcanoes, fracture zones thousands of miles long...mountains thrust out of the sea by volcanic action.



Giant comets, supernovae, black holes—what is really out there? Discover what we know about the planets ...the universe itself.

inside the fantastic world of your own body...



How's your health? Through the magic of a thermogram, technicians can detect hot spots that may signal a source of illness.

in the far reaches of space.

SPECIAL FEATURES

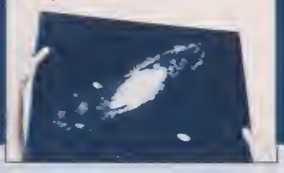
- Modestly priced, high quality hardcover volumes
- Large, 10¼ x 9¼" format for superbly detailed oversize illustrations
- Glossary of scientific terms • Hardbound for long use in your family
- More than 150 illustrations in every volume—including photographs, charts, diagrams and maps—many in full color
- 96 pages per volume • 35,000 words





Use this card to send for DISCOVERING THE SEA Yours for 10 days FREE

BONUS
Andromeda Galaxy
POSTER
Spectacular! 19½" x 26½"
Yours FREE just for examining your first book, if you circle the word BONUS above.



4BADJ2

YES! I would like to examine DISCOVERING THE SEA. Please send it to me for 10 days' free examination and enter my subscription to DISCOVERING. If I decide to keep DISCOVERING THE SEA, I will pay $8.95 ($9.95 in Canada) plus shipping and handling. I then will receive future volumes in the DISCOVERING series shipped one volume at a time approximately every other month. Each is $8.95 ($9.95 in Canada) plus shipping and handling and comes on the same 10-day free-examination basis. There is no minimum number of books that I must buy, and I may cancel my subscription at any time simply by notifying you.

If I do not choose to keep DISCOVERING THE SEA, I will return it within 10 days, my subscription for future volumes will be canceled and I will be under no further obligation.

NATURAL HISTORY

Name_____
(Please print)

Address_____ Apt.____

City_____

State or Province_____ Zip or Postal Code_____

All orders subject to credit approval. 4BADL8
Canadian residents, please mail this form in an envelope.

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

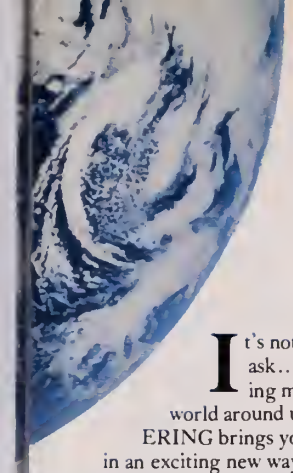
BUSINESS REPLY CARD

FIRST CLASS PERMIT NO 22 CHICAGO, ILL

POSTAGE WILL BE PAID BY ADDRESSEE



STONEHENGE PRESS INC.
303 East Ohio Street
Chicago, Illinois 60611



It's not just the kids who ask...we all like knowing more about the world around us. Now DISCOVERING brings you the answers in an exciting new way. Created in association with The American Museum of Natural History, it breaks science into manageable pieces and explains ideas simply, quickly, easily. After all, who knows more about making science fun than The American Museum of Natural History!

Your first volume DISCOVERING THE SEA takes you to earth's last frontier to explore its awesome geography...to learn how *tsunamis* or tidal waves can hit speeds of 450 mph...to see life flourishing in the lightless depths. You'll meet a creature bigger than any dinosaur, the great blue whale; it feeds on tiny krill—three tons a day! You'll see how beaches and deltas form...even how islands are created by nature's forces.

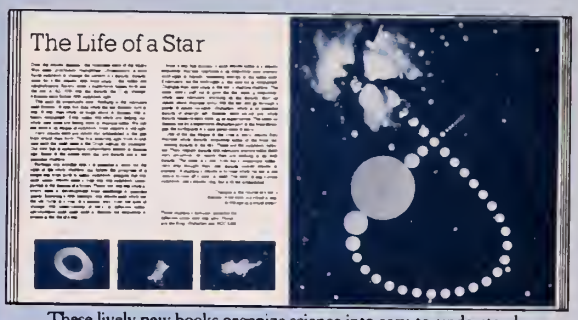
DISCOVERING THE SEA vividly demonstrates the way this new series can lead you through the wonders of today's science. As the series progresses, you will travel aboard the space shuttle *Columbia* to learn how its liquid- and solid-fuel systems produce its awesome lifting power. You'll explore other fascinating energy systems such as giant wind turbines and solar cells in space. You will venture into prehistory to look for the beginnings of life. You'll gain new understanding of the astonishing, tiny silicon chips that help computers speak...listen...draw pictures and design skyscrapers.

Here is a library for families with a curiosity about the universe and how it works. Books you'll refer to again and again. Colorful reading that will open your eyes to the wonders that surround you.

It's easy to discover the value of this new way of looking at science:

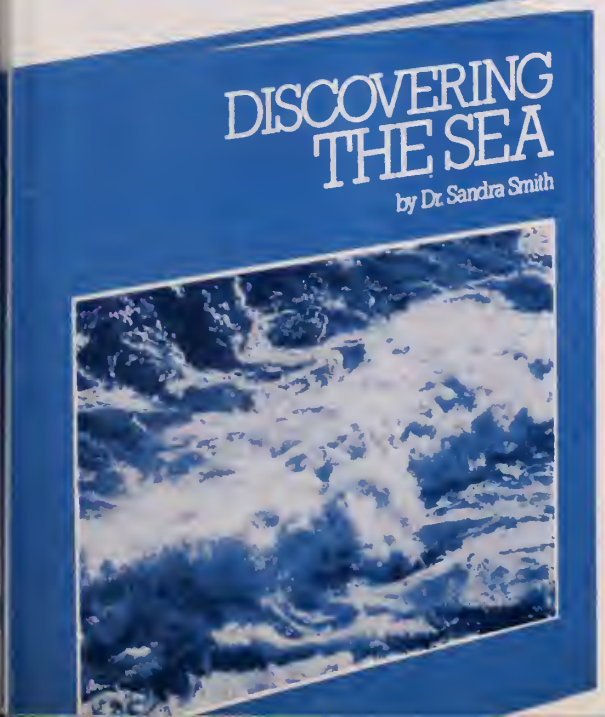
Enjoy DISCOVERING THE SEA for 10 days FREE. Then, if you wish, keep on DISCOVERING with your family. Succeeding volumes such as DISCOVERING ARCHAEOLOGY...ENERGY...ASTRONOMY...COMPUTERS...come one at a time. Each offers a rewarding look at an area of science at a remarkably modest price. See for yourself.

Unique format explains each concept quickly, completely



These lively new books organize science into easy-to-understand two-page units. This sensible approach lets you explore one complete idea at a time. It makes science easier to grasp ...and makes your reading fun and rewarding.

When they ask the tough questions, it's time for DISCOVERING



Explore your first volume DISCOVERING THE SEA for 10 days FREE

© 1981 Stonehenge Press Inc.

Mail today to: Stonehenge Press Inc.
303 E. Ohio St., Chicago, IL 60611

YES! I would like to examine DISCOVERING THE SEA. Please send it to me for 10 days' free examination and enter my subscription to DISCOVERING. If I decide to keep DISCOVERING THE SEA, I will pay $8.95 ($9.95 in Canada) plus shipping and handling. I then will receive future volumes in the DISCOVERING series, shipped one volume at a time approximately every other month. Each is $8.95 ($9.95 in Canada) plus shipping and handling and comes on the same 10-day free-examination basis. There is no minimum number of books that I must buy, and I may cancel my subscription at any time simply by notifying you.

If I do not choose to keep DISCOVERING THE SEA, I will return it within 10 days, my subscription for future volumes will be canceled and I will be under no further obligation.

4BADL8

Name_____
(Please print)

Address_____

Apt._____

City_____

State or Province_____

Zip or Postal Code_____

All orders subject to credit approval

Thermal Necessity

Fat, feathers, and the Franklin stove provide the warmth needed to sustain life

by Lisa Heschong

Life exists within a small range of temperatures. It comes to a standstill as water freezes, and even the hardiest of bacteria are destroyed in boiling water. Each species of plant or animal has limits within which it can survive and a narrow range of temperatures within which it can successfully compete with other species. Ecologists studying certain lakes have discovered that a change of as little as two degrees Fahrenheit in the average water temperature will shift the dominant fish species to either bass or catfish, as one species becomes more efficient than the other. Thus, not only extremes but even subtle variations in temperature can be critical to an animal's survival.

The oceans, where early life evolved, provide a particularly stable thermal environment in which organisms can live without much thermal stress. Fish and other coldblooded sea creatures can function perfectly well at the temperature of their watery environment because the temperature of the ocean—and thus of their bodies—varies so little, and then only very gradually. The land, however, experiences great swings of temperature. On a daily and a yearly cycle, the surface of the earth is constantly heating up and cooling down. The ground, in turn, heats the air around it, driving the forces of weather that can so dramatically change thermal conditions over the course of a few hours. The organisms that moved out of the oceans and onto the land were those equipped to survive both climatic extremes and wide daily fluctuations.

The most direct way to cope with an adverse climate is to not be there when it gets too hot or too cold. Many of the simpler forms of life, such as bacteria, fungi, and yeast, suspend metabolism—essentially, stop living—when the temperature becomes inhospitable. Similarly, many plants and insects live only during the most favorable season; when that season ends, they die off, leaving behind seeds or eggs that will sprout or hatch when conditions improve again.

If an organism is to survive through a yearly cycle of seasons, however, it must possess some thermal "strategy" more sophisticated than simply not being there. One way of almost not being there, short of dying, is to be deciduous, an adaptation displayed by plants not only in snowy climates but in desert climates as well. By dropping all of their leaves, deciduous plants reduce their exposure to temperature extremes. Metabolic activity continues—but at a greatly reduced level and only in a protected core or in roots sheltered underground. Coldblooded animals and some mammals deal similarly with extreme cold: they hibernate, retreating to a place sheltered from temperature extremes. As body temperatures drop, metabolic rates are greatly reduced, enabling the animals to conserve energy for survival through the dormant period.

Animals have a great thermal advantage over plants because they can move about. Good travelers, such as birds and large herd mammals, can migrate between entire climatic zones so that they can avoid the worst thermal conditions of any particular region. On a smaller scale, animals can also move about to take advantage of the variations in climate—the "microclimates"—that occur within a given landscape. Snakes, sluggish from the night's cold, will crawl out of their holes to bask in the morning sun. With the sun's heat they can raise their body temperature considerably and begin to function effectively even though the morning air may still be quite cold.

Indeed, coldblooded animals have various techniques to maintain a steady body temperature in spite of swings in the external temperature. Terrestrial coldblooded animals, unlike fish, are not completely at the mercy of their environment. In addition to moving to the best thermal location, they can also vary their muscular activity to generate more heat within their bodies. On a cold day, butterflies vibrate their wings for several minutes to warm their muscles enough so that they can fly. Lizards can maintain a body temperature to within one degree of their optimum by combining two strategies: to warm up, they do "push-ups" on a sunny rock; to cool down, they retreat to a shady crevice and lie still.

It is the genius of the warmblooded animals, the birds and the mammals, that they evolved with a system for regulating their internal body temperature that takes full advantage of the heat naturally generated by their metabolism. In mammals, the muscular heat-generating technique of the coldblooded animals is refined so that a change in muscle tone can produce subtle gradations in the amount of body heat produced. Vibrations of the muscles have become an automatic shivering response—an emergency heat-generating measure. Over longer periods of time, many mammals can actually raise their basal metabolic rate to acclimate to cold.

Even more significant than the ability to change the rate of heat production is the capability of warmblooded animals to regulate the rate of heat flow away from the body. A variety of mechanisms allow these animals to release their excess heat into the environment in order

Adapted from *Thermal Delight in Architecture*, by Lisa Heschong, by permission of The MIT Press, Cambridge, Massachusetts. Copyright © 1979 by The Massachusetts Institute of Technology.

Some people feel...

"So what if I'm young. I've never had an accident or even gotten a ticket. Why should I pay the highest insurance rates?"



That's why we want you to know...

We understand how you feel. You've got a good driving record, and that's great. And you don't expect to have an accident. No one does. But the fact is that good drivers as well as bad have accidents. That's why insurance protection exists.

No one can predict which individual is going to have an accident. But we can predict the accident potential for groups of drivers who share similar characteristics. This is the only way possible to make auto insurance rates.

Insurance companies set their rates to reflect how often they have to pay claims of insured groups and how much those claims cost. This is done for each state and for each rating territory within the state.

Year after year, without exception, statistics show a consistent pattern: younger drivers have more accidents than older drivers. Young males have more accidents than young females. And young unmarried males have more accidents than young married men.

The fairest way to distribute accident costs is for each driver to pay an insurance rate that reflects as closely as possible the exposure to loss of his or her group. Of course, differences within the groups also are taken into account. Among them are the age and type of car and how the car is used (whether for business, pleasure or commuting).

But take heart. If you have a good driving record, you will pay less than others in your group who have been involved in serious accidents or who have been guilty of major traffic law violations. And, as you get older, the accident potential of your group will decline, and so will your rates.

We're working to keep insurance affordable.

This message presented by the **American Insurance Association,** 85 John Street. NY, NY 10038

to stay cool or to insulate themselves so thoroughly that their body heat is retained even in the coldest of places. For example, by panting or sweating, mammals create evaporative cooling, the dissipation of body heat through the vaporization of moisture. And one of the most important ways warmblooded animals regulate the flow of heat is through the circulation of the blood. In mammals and birds, the amount of blood flowing to the surface of their skin or even to entire extremities is controlled. Flushing the skin with blood serves to pump the heat of the inner body to the surface, where it can readily escape. Conversely, restricting the flow of blood to the surface serves to retain the blood's heat in an animal's inner core. In many species of waterfowl, virtually all blood flow to the legs can be cut off, reducing the heat lost to cold water.

Mammals and birds have also evolved a marvelous variety of ways to insulate their bodies. Fat, which occurs in other animals only as lumps that store food energy, is deployed in many mammals as a special insulating layer under the skin. The thickness of this layer varies in response to seasonal demands for protection against cold. Polar bears and huskies have such an effective layer of fat that they can comfortably sleep on ice. Fur and feathers are other forms of insulation, capable of exquisite variation in quality, quantity, and even color over the course of a year. Smooth and sleek and a bit oily in the summer, an animal's coat protects its skin from the sun's hot rays; in winter the downy undercoat is thicker and can be fluffed up to provide an even more effective insulation. The goose bumps that humans get when they are suddenly chilled is a remnant of response from the time when our ancestors still had fur to fluff. A coat of fur or feathers essentially traps a layer of air with its own climatic conditions: the animal's skin is not exposed to the prevailing climate but to the warmer air contained within the coat.

When, in the course of evolution, human beings lost the thick mammalian fur coat, they also lost its capabilities for thermal control. Our naked skin functions well in the hot, humid tropics but needs some assistance in other climates. The traditional clothing developed by various cultures often has extremely sophisticated thermal functions. The billowing white robes of the Arab reflect away the sun's radiation, while helping to fan air past the body and increase evaporative cooling. At the other extreme, the Eskimo's fur parka keeps in both body heat and water vapor from perspiration so that the Eskimo essentially lives within a semitropical environment.

Human beings, like other animals, also use shelter as a means for thermal control. Nest building is, in a way, an advanced version of choosing the most favorable microclimate. Animals that use a rock crevice or a hole in the earth to escape the cold (or heat) are indeed seeking out a favorable microclimate. Digging the hole a little deeper and adding a bit of shed fur for insulation are simple improvements. All animals start their nests by finding the best location, but only a few of the most talented nest builders—some birds, beavers, and *Homo sapiens*—can completely transform an environment to meet their needs. For example, the Anasazi Indians of the southwestern United States were remarkably clever in choosing sites for their cliff dwellings. They invariably chose locations shaded in the summer by an overhanging ledge of the cliff but exposed to full sun all winter long. With their backs to the cliff, the dwellings were protected from the winter winds and also took advantage of the thermal mass of the earth to moderate the temperature flux.

Buildings, even in the conventional ways they are constructed now, can be viewed as a way to modify a landscape to create more favorable microclimates. As soon as a simple square hut is built, at least six new microclimates are created: the south side warmed by a sunny wall; the north side in shade most of the time; the east side with its morning sun and perhaps protected from the prevailing breeze; the west side warmed in the afternoon but buffeted by the wind; the interior with its shelter from rain, wind, and sun; and the roof, raised above ground level and more exposed to the elements. A building increases the range of available thermal zones so that people can select the microclimate most suited to their thermal needs.

Vernacular building traditions all over the world display remarkably sophisticated adaptations. Primitive builders consistently used forms and materials that effectively moderated prevailing climatic conditions. For example, in the desert the characteristic problem is extremely high daytime temperatures coupled with uncomfortably low temperatures at night. The ideal building material would have a high heat capacity—to absorb solar radiation during the day and slowly radiate it back at night. Thus, buildings of adobe, mud and rubble masonry, and thick clay mortar on twig mesh are found in the American Southwest, the Middle East, and across Africa. A particularly ingenius response to climatic needs is seen in the Eskimo igloo. Using material of very low thermal capacity—dry snow—the Eskimo builds a small dome, a shape both resistant to wind and easily heated by a single oil lamp. A glaze of ice, which automatically forms on the inside surface, seals the structure and acts as extra insulation, along with furs that are draped against the wall. Clever use of the insulating qualities of snow is not unique to the human inhabitants of the Arctic. Many arctic animals bury their nests deep in the snow; protected from winds the animals' body heat can warm the enclosure. But the Eskimo has one transcendent advantage—the use of fire.

Fire offers enormous potential for affecting the thermal environment. Plants and the simpler animals are totally dependent upon the sun and weather to provide the heat necessary for their survival. Coldblooded animals make use of their own body heat to help keep themselves warm, and warmblooded animals are masters at regulating this internal source. Fire allows human beings a third mechanism, one independent of the fluctuations of climate and their own metabolism. With the control of fire, people can generate heat at will to warm themselves and their environment.

The most primitive dwelling was typically just a small round shelter with a fire pit at its center. In Europe, as late as the Middle Ages, it was still common practice to have an open fire in the center of a room with the smoke escaping through a hole in the roof gable. Such fireplaces were extremely inefficient, causing as many heating problems as they solved. Flames were more valued than embers, but large, open fires consumed great quantities of oxygen, pulling the cold outside air in through the cracks of the building as quickly as the heated air escaped through the roof hole. Since the air inside the dwelling would not stay heated, the only way to benefit from the fire's warmth was to sit directly in front of the flames.

About the end of the Middle Ages chimneys began to be used to channel off the smoke of a fire. Early chimneys were made of wood, but people soon

realized that a stone or brick chimney was not only safer but also absorbed heat from the fire and later radiated it back into the room. To take advantage of this form of heat storage, people began to build ever more massive masonry chimneys. In homes in northern Europe, these chimneys evolved into a huge central structure that might incorporate a number of fireplaces, ovens, and flues, with a sleeping loft on top where a bed could be kept deliciously warm.

As firewood became scarce, however, people looked for a heating system that would be more efficient than an open fire. At the end of the eighteenth century, the American-born physicist Count Rumford endeavored to make a science of fireplace efficiency, designing a fireplace that radiated a much greater percentage of its heat into the room. Benjamin Franklin had an even better idea, putting the fire in a metal box installed within the fireplace. His design included a separate air box through which fresh air could be circulated and heated, uncontaminated by the gases of combustion. Later manufacturers simplified the concept, moving the stove out into the middle of the room, where its heat could radiate in all directions. The Franklin stove was the "Model T" of the heating business, mass produced and the pride of households all over the country.

With the Franklin stove came the revolutionary idea that a fire could heat a house indirectly—by heating the air, which could then be circulated to keep people warm anywhere in the house. This idea initiated the changeover from a radiant to a convective system of heating. Improvements were made to extract more and more heat from the firebox, and the stove was transformed into a furnace. For the first time a building was seen as an enclosure for a bubble of warmed air, and attention began to be paid to making the enclosure more airtight. Merely blocking out the rain and wind was not sufficient in an air-heated house, for if a building still leaked air, pressure from the wind could drive all of the heated air to one side of the house and out through the walls.

In the nineteenth century, the new scientific understanding of the processes of convection and radiation brought a flurry of efforts to design the perfect furnace—safe, clean, efficient, and inexpensive. At first, natural convection, which depends on gravity, was most commonly used to move warmed air



Up until now you've been seeing less than what you paid for–30% to 50% less. Here at last is a mini that compensates for the distance between the eye and the eyepiece to give eyeglass wearers full field of view. Wearing glasses, you get 30% greater field of view than with the best of other minis–300 feet at 1,000 yards as against 174 feet at 1,000 yards.

Though a pygmy in size, it performs like a giant. With all the magnification, brilliance, clarity and contrast of its big brothers. Built to last a lifetime, it's guaranteed to last a lifetime.

Send for full color brochure showing and describing complete Zeiss line. Carl Zeiss, Inc., 444 Fifth Avenue, New York, N.Y. 10018.

Carl Zeiss, Inc.
Consumer/Optics
Division

ZEISS
West Germany

A BREAKTHROUGH FOR EYEGLASS WEARERS. THE ONLY MINI THAT GIVES YOU FULL FIELD OF VIEW.



through a house, but pressure differentials and temperature stratification tended to create a very uneven distribution of heat. Steam heat looked promising for a while because it solved the problem of moving heat from where the fuel burned to where the heat was actually wanted. The steam could be piped under its own pressure and then, on losing its heat, would condense back to water and return by gravity. Steam radiators, however, were noisy and excessively hot. With the development of small electric motors, heat distribution problems were more easily and comfortably solved. Small electric pumps could move warm water noiselessly through baseboard convectors, and electric fans could force warmed air to every corner of a building. In addition, these motors could be controlled with electric signals from thermostats so that a steady temperature could be automatically maintained.

By the early part of this century the technology of heating with mechanical systems had been worked out fairly well. But heating is only half of the climate-control problem and by far the easier half to solve. It is much simpler to generate and retain heat than to dispose of it. In hot, dry climates people have long depended on evaporation to dispose of unwanted heat, using systems of fountains, plants, and even permeable clay pots filled with water to cool and humidify the air. But in humid climates evaporation is greatly inhibited and radiational cooling to the night sky is also reduced. This made it nearly impossible to cool a place in hot, humid weather until the advent of air-conditioning technology—a revolutionary step in climate control.

About the turn of the century, Willis Carrier, an American engineer, hit upon a way to simultaneously dehumidify and cool air. He developed the somewhat paradoxical system of dehumidifying air by passing it through a spray of water. Based on the principle that cold air cannot hold as much absolute humidity as warm air, Carrier's system passed warm humid air through a spray of chilled water. In this way, the air was cooled and forced to lose its excess humidity, which would then condense on the surface of the water droplets in the spray. By choosing how cold to make the water spray, it was possible to control exactly how much humidity would be left in the air. The air could be reheated to a comfortable room temperature,

yielding air at precisely the temperature and relative humidity desired. With Carrier's discovery, for the first time all the elements of thermal control were available.

In recent years, standards for thermal comfort have been incorporated into many municipal and state building codes in the United States. Nowadays, there is an underlying assumption that the best thermal environment is one that need never be noticed, and that once an objectively "comfortable" thermal environment has been provided, all of our thermal needs will have been met. Our extremely sophisticated environmental control systems are all directed to this one end.

To maintain such unnatural uniformity, however, not only requires a great deal of effort and energy but also overlooks an important aspect of the way human beings experience a space. Such thermal qualities as warm, cool, humid, and airy and, in particular, the juxtaposition of these qualities provide a special source of comfort and even delight. We all love having our world full of colors—every color in the rainbow and then some. Even though studies have shown blue to be the most restful color, I doubt that anyone would put forth an argument for a monochromatic world. And yet a steady-state thermal environment is the prevailing standard for office buildings, schools, and homes across the United States.

The steady-state approach to the thermal environment assumes that any degree of thermal stress is undesirable, that people must be spared the effort and the distraction of adjusting to different conditions. And yet, in spite of the extra physiological effort required to adjust to thermal stimuli, people definitely seem to enjoy a range of temperatures. Indeed, they frequently seek out extreme thermal environments for recreation or vacations. This must explain in large part the love of the Finns for their saunas and the Japanese for their scalding hot baths. Americans flock to beaches in the summer to bake in the sun and travel great distances in the winter to ski on frosty mountaintops. People relish the very hotness or coldness of these places. There is far more richness in the thermal environment than just one zone of comfort. The thermal environment has the potential to provide us with sensual delights and cultural associations that should not be designed out of existence. □

Q. What is the new WEBSTER'S DELUXE UNABRIDGED DICTIONARY about?



A. It's about 2,300 pages and more than 4 inches thick!

For more than 40 years Webster's Unabridged Dictionary has served as an invaluable reference for students, teachers, businessmen, secretaries . . . and workers in all trades and professions. The reason is simple. Here is a dictionary that fills the need for accurate and full definitions, correct spellings and pronunciations, full etymologies, synonyms, as well as other general and specific information.

A large staff of lexicographers and linguists has painstakingly edited and updated each definition so that it is clear, accurate, and readily understood in all its senses. Many new entries have been added, including recent additions to the language in the natural and social sciences, the humanities and other specialized branches of human knowledge.

un à bridged′, *a.* not shortened; complete; specifically, designating a dictionary that has not been abridged from a larger work.
un aç cent′ed, *a.* not accented; specifically, in

The large, clear, legible type shown above (actual size) "makes this unabridged dictionary the most readable one in print."

. . . now own one of the finest reference books in the world at less than ⅓ of its originally published price.

DELUXE COLOR EDITION
Includes Thousands of Illustrations Along With a Complete Collection of Full-Color Maps of the World

Plus it contains these important supplements!

1. A Dictionary of Biography
2. A Dictionary of Geography
3. A Dictionary of Noted Names in Fiction, Mythology, Legend
4. A Dictionary of Foreign Words and Phrases
5. A Dictionary of Scripture Proper Names and Foreign Words
6. Abbreviations Commonly Used in Writing and Printing
7. Practical Business Mathematics
8. Forms of Address
9. Tables of Weights and Measures
10. Special Signs and Symbols
11. Presidents of the United States
12. Vice Presidents and Cabinet Officers of the United States
13. Declaration of Independence
14. Constitution of the United States
15. History of Canada
16. Charter of the United Nations
17. Air Distances between Principal Cities
18. Principal Geographic Features of the World
19. Commercial and Financial Terms

BARNES/SALE & NOBLE/ANNEX **SAVE $50**

MAIL ORDER DEPT. WD541
126 FIFTH AVE., N.Y.C. 10011

Published at $69.95
NOW ONLY $19.95

Please rush me _____ copies of *Webster's Deluxe Unabridged Dictionary* at your special sale price of $19.95 (plus $3.00 postage and handling) N.Y. and N.J. Residents Add Sales Tax.

Mr. ☐ Ms. ☐
NAME (Please print clearly)
ADDRESS
CITY ZIP

FOR FASTER SERVICE
CREDIT CARD CUSTOMERS
CALL TOLL FREE 1-800-228-2057 / EXT. 15
Lines are open 24 HOURS
7 DAYS A WEEK including Sundays
In Nebraska call 402-571-4900

THE BARNES & NOBLE MAIL ORDER GUARANTEE
Every book you purchase from Barnes & Noble by mail must meet your standards. If not . . . return it for a full refund within 30 days or credit to your charge account.

In business for 105 years, Barnes & Noble has become "the world's largest bookstore." (See the current *Guinness Book of World Records.*) Our goal is to sell the finest books in the world at the lowest possible prices. Ask about us at your local school or public library.

I prefer to charge this purchase: ✓Check One
Card ☐ VISA ☐ MasterCard ☐ 4 digits above your name
Account# Exp.
Signature

© 1981 Barnes & Noble Bookstores, Inc.
Offer good only in the continental U.S.A.

Hearth and Home in the Old Stone Age

Lighting a fire was only one of the ways prehistoric humans kept warm

by Catherine Perlès

Early human populations did not, in most regions and periods, have to withstand a very cold climate, but numerous prehistoric hunter-gatherers did adapt to cold steppe and tundra environments, surviving the periodic onslaughts of the Ice Age glaciers. Archeological knowledge of the means of such adaptation is, however, still largely hypothetical. The remains of fur clothes, skin dwellings, and similar organic materials are rarely preserved, so the existence of such items usually can only be inferred from indirect evidence. And while fire leaves traces of calcination—powder and ash formed by the action of the heat—interpretation of these traces is still difficult. Burned bones or stones, ashes, and charcoal all attest to the use of fire but seldom tell us its purpose: hearths lit for heating or lighting a habitation or for grilling meat leave very similar traces.

Although the earliest stone and bone tools were made by humans living in Africa some 3 million years ago, the oldest evidence discovered of the use of fire comes from Europe (l'Escale and Terra Amata in France, Vertesszölös in Hungary) and Asia (Chou-k'ou-tien in China). The European sites are attributed to the second glacial period (500,000–400,000 years ago) while Chou-k'ou-tien dates from the warm interglacial period that followed. Several other Eurasian examples date from the third glacial period (200,000–100,000 years ago), whereas in Africa, evidence of fire seems to be of a much later date.

That the use of fire should appear first in northern regions and during relatively cold periods has often been taken as proof that fire was a prerequisite to the colonization of what was an inhospitable environment. According to this argument, early hominids (*Australopithecus* and *Homo habilis*) were confined to the ancestral African home because they lacked fire, while at a later stage, more evolved hominids (*Homo erectus*) were able to expand all over the world with the aid of fire. While it is true that all the oldest traces of fire can be attributed to *Homo erectus*, this does not necessarily establish a link between fire and the colonization of Eurasia. Fire, with its many applications, is just as useful in Africa as anywhere else, and it would be premature to conclude that it is not as ancient on that continent. Furthermore, the European climate during the second glaciation was not very cold, and the Vertesszölös hearths actually date from a warm interphase that occurred during the second glacial period. Most important, perhaps, is that an even larger number of Eurasian sites of the same antiquity, and sometimes older, show no trace of fire use, demonstrating that prehistoric humans could adapt to these colder environments without an artificial source of warmth.

In fact, the use of fire seems to have spread rather slowly in Europe and Asia. All throughout the Lower Paleolithic (from 3 million to 100,000 years ago), hearths and other remains of combustion are scarce; not until the Middle Paleolithic (from 100,000 to 35,000 years ago), does the use of fire become the rule rather than the exception. This change has often been interpreted as a major technological shift from the (unreliable) preservation of embers from natural sources to the systematic production of fire. Unfortunately, it is unlikely that we will ever be able to prove this hypothesis because the simplest fire-producing devices leave no specific traces in prehistoric sites.

Many technologically simple means to create fire have been feasible for several hundred thousand years. These primitive methods can be grouped into two categories: percussion between two stones and friction between two pieces of wood. Rapid friction between two sticks of wood will generate sufficient heat to kindle such flammable material as dry moss, tow (plant fibers), or sawdust. Friction can be produced manually by a sawing motion or by placing one stick of wood on another and twirling, or rotating, it between the palms of the hands. One method of speeding up rotation, and thus enhancing the efficiency of the fire drill, is to loop a leather strap or bowstring around the stick and draw it back and forth. Lighting a fire by striking two stones together is generally more difficult. If two pieces of flint are used, the tiny sparks produced must come immediately in contact with very flammable tow. It is easier to produce fire by striking flint against a "fire-stone" of iron mineral such as pyrite or chalcopyrite, both abundant in nature.

All such apparatuses for making fire are light and easy to carry, and their elements are easy to replace; equipped with them, prehistoric people could have produced fire wherever they were. But archeologists have little indication of when these possibilities were first exploited. Except in unusual circumstances, wood disappears when buried in the ground, so there is little hope of finding wooden fire drills or sticks. A few remains, such as a carbonized stick found at Krapina, in Yugoslavia, are not convincing evidence. Flints for starting fires must have been preserved, but we have not been able to distinguish them from other tools made of knapped, or chipped, stone. As for the pyrite fire-stones, the most ancient one recovered dates only from the Upper Paleolithic (35,000 to 12,000 years ago); these tools seem to be more abundant in later sites, such as the Mesolithic settlement of Star Carr in England (9,500 years ago).

We may never know when human beings learned how to produce fire, but this technological achievement may have had fewer implications than the discovery of the use of fire itself. From the very beginning, the acquisition of fire must have meant a new distribution of tasks within the prehistoric group. Some members may have specialized in maintaining the fire—important for symbolic as well as practical reasons—while others collected the necessary

Come play in our backyard.



All the Americas are our backyard. And in South America, we know the best places, sights, tours and experiences. We take you to Quito, Guayaquil, Rio de Janeiro, Lima, Santiago, Buenos Aires, São Paulo and Panama with dependable, frequent service from New York, Los Angeles and Miami. We also serve Bogotá, Cali, Caracas, Mexico City and Nassau. And we offer the finest, most convenient service any major airline can provide. The fun begins when you ask your travel agent. Or ask us. Call toll-free for information and reservations: 800-327-1337. In Florida, 1-800-432-1372. In Miami, (305) 526-5734.

ECUATORIANA
the world of Ecuatoriana

TALL & BIG MEN

Send for this FREE Catalog



Finally, you can get a good selection of great-looking clothes that fit!

Instead of getting sold short in stores that carry only a limited selection in your size, send for 96 pages of smart looking clothes guaranteed to fit!

What a guarantee!

Your order from The KING-SIZE Co. is GUARANTEED both BEFORE and AFTER Wearing, Washing or Dry Cleaning. Unless you are fully satisfied, you may send it back for a full refund or exchange.

IT'S ALL HERE!

- ★ Brand-name shirts up to 22" neck and 38" sleeve
- ★ Slacks and jeans to 60" waist and 38" inseam
- ★ Jackets and outerwear to size 60
- ★ Shoes, boots, work shoes and sneakers to size 16EEE.

FREE 96 PAGE COLOR CATALOG

Please
Send the latest KING-SIZE Catalog to me at the address below

My Telephone Number ___ (Area) _____
NAME _____
ADDRESS _____
CITY _____
STATE _____ ZIP _____

THE King-Size Co.
7021 King-Size Bldg. Brockton, MA 02402

fuel. And the custom of preparing and taking meals in common—a major source of cohesion and exchange in human groups—may date from when food could be cooked. Assuming that the burned bones found discarded in prehistoric dwelling sites are evidence of meat cooking, then cooking goes back to *Homo erectus* of Lower Paleolithic times. (One can also argue that the bones were only used as fuel. For example, in the absence of abundant wood, the mammoth hunters of central Europe and the Russian plain used mammoth bones as a primary fuel.)

An early example of how effectively fire could be used for heating can be found at the Lower Paleolithic site of le Lazaret, at Nice, where a hut was built about 150,000 years ago in a small cave overlooking the sea. The hut was made by leaning wood poles against the cave wall and covering them with animal skins, which were anchored to the ground by stones. Inside were two small hearths, which (if the hut was windproof) could have maintained the 500-cubic-foot interior at a temperature of 60° to 70°F while it was 25° outside. In general, a Paleolithic dwelling several meters in diameter had just one hearth.

In the cold Upper Paleolithic, prehistoric peoples apparently developed a technique for preserving as much heat as possible from the fireplace. Several sites of this period (notably in France, where Paleolithic hearths have recently been examined in detail) have yielded hearths that were either filled or covered with a dense layer of burned pebbles or angular stones (sandstone, granite, limestone, and so on). In some instances, it has been possible to prove that the stones were laid on burning embers and not removed afterward. A likely explanation is that the stones were meant to accumulate heat when the fire was at its maximum and to give it back slowly during the night or conserve it during a temporary absence. At the same time, the system would have allowed for the economizing of fuel, which may already have been a preoccupation in Paleolithic times. Each time such a hearth was used, of course, it had to be cleared of the stones, which could be reused until they became too fragmented by the heat. This interpretation is plausible and has been ethnographically documented, but there is another possible explanation. The idea may have been to heat the stones and then use them for boiling, roasting, or drying food; for drying and heating flint before knapping it; for heating antlers before working them; or for other purposes.

Indeed, the use of fire as a tool is easier to document than its use for warmth because the remains of materials worked in fire are modified in ways that we can still observe. For example, in some rare Lower and Middle Paleolithic sites, exceptional conditions have preserved wooden tools that were pointed and hardened in fire, such as the digging sticks at Kalambo Falls in East Africa and the spear of Lehringen in Germany. By the Upper Paleolithic, fire was used to fracture or treat flint, antlers, ivory, and bone and to reduce and oxidize natural ochers for painting. A first attempt at ceramics appears in fired figurines found in central Europe. And fire probably served as a tool in such activities as forest clearing, tree felling, and game hunting.

Fire's many technical applications, as well as its importance for cooking and lighting, make it hard to determine how important the Paleolithic fireplace was for heating. But what should be emphasized is that fire was neither the first nor the only way that humans discovered to fight cold.

A wind- and moisture-proof dwelling—a hut or tent—would have been one of the most efficient defenses against cold. The covers of tents or huts, which were probably made of organic materials, are not preserved, but the remains of stones, rings of pebbles, or folds of earth that were used to fix a cover to the ground can often be found. There were Paleolithic huts made of reindeer bones and antlers or mammoth bones and tusks that had an intricate dome structure to support and fix a heavy, weatherproof cover. Experiments have shown that a cover sewn together from reindeer skins (reindeer were widely hunted in Upper Paleolithic Europe) would have provided excellent protection against cold, rain, and snow.

The best protection would have been individual clothing, which conserves body heat. Unfortunately, nothing is known about clothing during the Lower Paleolithic, although fur clothes were probably used. Numerous bone and ivory needles from Upper Paleolithic sites indicate that clothes were being sewn some 17,000 years ago. Before that, sewing could have been done with bone or stone borers. To get an idea of the clothes themselves, we have to turn to figurines and burial sites. Most of the

female figurines from the Paleolithic era do not depict clothing, but there is at least one from Buret' in Siberia that is dressed: a slim figure depicted with trousers, a vest, and a hood, not very different from traditional Eskimo garments. In many Paleolithic burial sites, long rows of shells and beads on the head, body, and sometimes feet still show the shape of the cap, clothes, or shoes to which they were attached. And just at the end of Paleolithic times, one small boy was buried with a short-sleeved jacket made of red squirrel tails, whose bones have been preserved in perfect order (in the cave of Arene Candide, in Italy).

Many furry animals are carnivorous and, being dangerous quarry, are not usually appreciated for their meat. Thus, the remains of lynxes, wolves, foxes, and similar animals found at prehistoric sites suggest that they were sought for their fur, which was used for clothing, rather than their meat. Furs could also be spread on the ground and used as blankets. In the two-hearth hut in the cave at le Lazaret, the claws of furry animals were found to have the same spatial distribution as the shells of very small crustaceans that live on algae; it appears that the inhabitants spread beds made of algae and furs around the two small hearths. In most Upper Paleolithic habitations, the ground is heavily colored with ocher. Since ocher is still used by some peoples in the tanning of skins, it is possible that this coloring reflects, not the ritual spreading of ocher on the ground, but the much more prosaic use of furs and skins.

In sum, the traditional image of prehistoric humans in constant struggle against cold rests largely on an overestimation of the harshness of the climate and an underestimation of Paleolithic capabilities and technology. Moreover, the human body itself, helped by an appropriate diet, is able to develop natural defenses against extreme cold. In regions around glaciers, prehistoric hunter-gatherers ate marrow and animal fat in large quantities, and this may have been their most efficient means of resisting the cold. Despite the rather poor archeological data, we can conclude that human adaptation to cold in prehistoric times relied on a variety of factors and techniques. Someday, we may be able to distinguish specific cultural groups that adopted differing strategies of keeping warm. □

Buy 40 beautiful UNICEF note cards. And help a billion beautiful children.





This is the famous UNICEF Super Box Collection — 40 beautiful cards, including 15 note cards with envelopes, 15 minis with envelopes, and 10 multi-lingual inserts (Happy Birthday, Happy Anniversary, Thank You, etc.). Plus 10 petite gift enclosures.

It's a super value at only $9.

And the best part is, the proceeds help support health and education for a billion children in 111 nations. So *every* note you write is a love note to the underprivileged children of the world.

PS: The Super Box makes a super gift — a gift that says you're truly involved.

Famous UNICEF Cards. They say beautiful things about you. Before you ever write a word.

U.S. COMMITTEE FOR UNICEF
331 East 38th Street
New York, NY 10016

Add $2 for postage and handling.
of boxes _____ ($9.00 per box.)

Name _____

Address _____

City _____ State _____ Zip _____

☐ MasterCard ☐ Visa ☐ Personal Check (Please, no cash or stamps)

Acct # _____ Signature _____
(Required for Credit Card purchases)

To order faster call toll free 1-800-228-1666 In Nebraska 800-642-8787 NE



Eskimos Are Warm People

Their vision of hell is that of a cold place, and they have no intention of living it on Earth

Text and photographs by Fred Bruemmer

Since man originated in a warm climate, presumably Africa, this furless relative of the apes was poorly designed by nature to cope with cold. Naked humans today are comfortable at an ambient air temperature of about 75°F. At temperatures lower than this, we begin to feel chilly and respond by shivering, which roughly triples the body's heat production, and by having goose pimples, a pathetic vestigial attempt to fluff out the protective fur our forebears had. When the air temperature is low enough to sap body heat faster than it can be generated, the body's core temperature is lowered, and we are immediately in grave trouble. Our normal body temperature is 98.6°. At 91°, our thermoregulatory system begins to falter.

According to David E. Bass of the U.S. Army Research Institute of Environmental Medicine, "Man becomes incapable of conscious, lifesaving decisions when deep body temperature is lowered by only seven degrees. Furthermore, long before this point is reached, he has become subjectively so uncomfortable that he must spend 100 percent of his effort toward mere survival." A naked human exposed to −40° temperature and winds of thirty miles per hour—conditions common in the Arctic—would die in about fifteen minutes.

Given this hereditary sensitivity to cold, it is not surprising that the ancients living in southern climes contemplated the north with dread and loathing. In 430 B.C., the Greek historian Herodotus wrote about the northern regions of Europe: "The whole of the country . . . has so hard and severe a winter, that there prevails there for eight months an altogether unsupportable cold."

Yet people did live in the north of Europe. And at the same time, precursors of the modern Eskimos inhabited the much harsher North American Arctic, from Alaska to East Greenland and north to the very limit of land, on Ellesmere Island and in Peary Land. Today, in these regions, the mean January temperature is −30°, temperatures can drop to nearly −70°, winter storms are frequent, and the sun sets on October 20 and does not rise above the horizon again until early March. In the Thule region of northwest Greenland, home of the Polar Eskimos, only one month, July, has an average temperature above the freezing point. Yet contemporary Eskimos call this region *Nunassiaq*, "the beautiful land."

This may seem a strange description of the harshest, most hostile, and potentially most lethal environment ever inhabited by humans. But the prehistoric Eskimos, who knew only their land, did not think of it as being extraordinarily harsh or hostile. To them it was simply *nunavut*, their homeland, and until missionaries and explorers told them otherwise, they believed it to be the best of all possible worlds, a land and a sea rich in game. Nor did they necessarily find other lands and other climes more genial and alluring. In 1851, after a fruitless search for the missing Franklin expedition (whose 129 officers and crew all perished on their ill-fated search for the Northwest Passage), Capt. Erasmus Ommanney returned to England, taking with him Kallihiruas, a young Polar Eskimo from northwest Greenland. Kallihiruas lived for four years in Canterbury and, dressed in European clothes, was pitifully cold. In 1855, he wrote a plaintive letter to an English friend: "I been in England long time, none very well. Very bad weather. . . . I very sorry, very bad weather dreadful. Country very different. Another day cold. Another day wet. I miserable. . . ."

For a people whose ancestors have lived in the far north for at least 10,000 years, the Eskimos have few physiological adaptations to the severity of the climate. They can digest and assimilate fat better than Europeans. Their basal metabolic rate is 20 to 40 percent higher than that of people in more southerly regions. Their hands and feet are small, and in cold conditions, the blood flow to the extremities is more intense than in most other human groups. Vasodilation (the widening of blood vessels) permits abundant blood flow to the hands, and as a result, Eskimos have warm hands even in cold weather.

But while such physiological adaptations help protect hands and feet and, equally important for a hunting people, insure manual dexterity even in very cold weather, they are only minor components of the Eskimos' survival kit. To protect themselves from the lethal cold of the arctic climate, the Eskimos' forebears invented, in the words of the explorer Vilhjalmur Stefansson, "a system of living perfectly adapted to a cold climate. . . ." It took millenniums to attain this perfection.

Just when and where the Eskimos originated, and why they chose the Arctic as their home, are subjects of conjecture. People of Arctic Mongoloid stock probably came from Siberia across the Bering Strait to Alaska about 10,000 years ago, at a time when the ancestors of the Indians had already preempted most of North America except the Arctic. Some specialists think that these people are ancestral to both Eskimos and Aleuts and call them Eskaleuts.

For a hunting people, the Arctic had its attractions: millions of caribou, tens of thousands of musk oxen, millions of birds and seals, and plentiful whales and walruses. But for the first humans to colonize this game-rich but climatically

On the Belcher Islands in Hudson Bay, the Eskimos made parkas from the skins of eider ducks when caribou were not available. Eider parkas were light and warm, but more fragile than those of caribou fur.



Caribou skins are spread hair-down on the ground to dry, left. The Eskimo woman, right, is cleaning a caribou skin, preparatory to making it into a parka. Bannock is baking over the seal oil lamp.

daunting realm, life must have been an excruciatingly difficult struggle for mere survival. The people of the Arctic Small Tool Tradition, presumed to be descendants of the Eskaleuts, nevertheless spread eastward from Alaska about 5,000 years ago, and within a span of roughly a thousand years occupied the Arctic all the way north to Ellesmere Island and east to East Greenland. They lived year-round in small tents, which they probably could not heat because they apparently did not have oil lamps. They lacked the toggle harpoon so essential for successful sea mammal hunting. They probably had neither boats nor dog teams. Yet somehow they persisted, a few thousand people scattered across the immensity of the Arctic, leading a life so hard that later Eskimo cultures appear positively luxurious by comparison.

From these people of the Arctic Small Tool Tradition other cultures evolved—the pre-Dorset and, about 800 B.C., the Dorset culture, which spread from its core area in northern Hudson Bay and Foxe Basin, to northern Ellesmere Island, west to Victoria Island, and south to Newfoundland. The culture of the Dorset people was distinctly Eskimoan. They had more elaborate tools and hunting implements and a way of life much better suited to the Arctic than that of their predecessors. But the Eskimos' cold-adapted culture did not reach a state of near perfection until the arrival of the so-called Thule culture people, who moved eastward from Alaska about A.D. 800 and within less than 200 years spread across most of the North American Arctic, displacing or absorbing the Dorset people.

Superb sea mammal hunters, Thule culture Eskimos pursued and killed everything from the small ringed seal to the giant bowhead whale and, according to archeologist Robert McGhee of Canada's National Museum of Man, they had evolved "a technology more complex than that of any other preindustrial society, which allowed not only an economically efficient but also comfortable way of life throughout arctic North America." These Eskimos invented, perfected, and passed on to the Eskimos of historic times such a plethora of specialized tools and hunting equipment that the late James A. Ford of the American Museum of Natural History described them as "gadget burdened."

This is the more amazing because not only was their land exceedingly cold, hostile, and barren, it was also poor in those raw materials most societies have found essential. Metal was rare: meteoritic iron, brittle and hard to work, was found in the Cape York region of northwest Greenland and native copper in a few areas of the central Canadian Arctic. Driftwood was abundant along Alaska's coast and east past the Mackenzie River delta; it was rare in the eastern Arctic and virtually nonexistent in the central Arctic. That left stone, ice, snow, and sod as the most readily available and most widely used materials that the land and sea provided. Infinitely more important to the Eskimos were the materials they obtained from the animals they killed: bone, horn, baleen, antlers, teeth, ivory, furs, skins, sinews, and intestinal tissues. As Dionyse Settle, the Elizabethan chronicler of explorer Martin Frobisher's second expedition to Baffin Island, so shrewdly observed in 1577: "Those beastes, flesh, fishes, and fowles, which they kil, they are meate, drinke, apparel, houses, bedding, hose, shooes, thred, saile for their boates . . . and almost all their riches."

The earliest description of an Eskimo winter home comes from Frobisher's third voyage to Baffin Island in 1578. George Best, one of Frobisher's officers, wrote: "From the ground vpward they builde with whale bones, for lack of timber, which bending one ouer another, are handsomly compacted in the toppe togither, and are couered ouer with seales skinnes. . . ."

The Eskimos inhabited similar winter houses when anthropologist Franz Boas lived with them on Baffin Island in 1883 and 1884. The base of a house was built of stones and whalebones (occasionally incorporating entire whale skulls). The rafters and framework were made of whale ribs and jawbones. These were covered with seal or walrus skins, then came a thick layer of dried heath, and the whole was securely wrapped with a second layer of animal





In summer, Eskimos traditionally lived in caribou-skin tents. These provided ample shelter from rain and storms. The kayak, which was important for hunting, is made of depilated caribou skins.

skins. In winter the entire structure was covered with an ample layer of snow. A window was made by sewing together the translucent, parchmentlike intestines of a bearded seal, and stone slabs were used to pave the entrance: a long, low passageway that sloped upward to the hut. This entrance was the essential and ingenious feature of all Eskimo houses, whatever their design. Since warm air is lighter than cold air, none of it escaped downward through the entrance. Conversely, only enough cold air entered the building to replace the stale, hot air that seeped out of the vent in the top of the house, thus providing gentle ventilation without draft. "This kind of hut," said Boas, "is very warm, light, and comfortable." Such *qagmaqs*, made with wooden frames and canvas covers instead of skins, were still used in a few isolated camps on southern Baffin Island until the early 1970s.

In the western Arctic where driftwood was plentiful, house frames were built of timber and thickly covered with sod and snow. In 1827, Lt. Edward Belcher of the British expedition ship *Blossom* visited a native home at Point Hope, Alaska, and was "much surprised to find so much neatness, cleanliness and comfort in the great apartment." But he found the temperature in the house "very oppressive."

These one-room houses were nearly perfectly insulated and were warm even in the coldest weather. "The typical Eskimo house in the afternoon and evening (when lamps burned high to cook supper)," said Stefansson, "resembled a sweat bath," and the people in it sat stripped to the waist, sweltering. At night all lamps but one were doused to bring the temperature down to 50° or 60° and "both sexes and all ages slept completely naked, under light robes." About half the room was taken up by a raised sleeping platform built of stones and covered with dried heath or moss. On top of this layer, caribou furs were spread—usually the long-haired skins of early winter, the first layer hair-down, the second hair-up—to form a warm, soft, deep-pile mattress. In two or more *kudliks*—shallow, crescent-shaped lamps carved of soapstone with wicks made of a mixture of dried, rubbed moss and the bolls of cotton grass—seal oil or whale oil burned with one- to two-inch-high flames, providing both heat and light. Above these lamps the Eskimos cooked their meals, usually meat and fat and occasionally fish, in "pannes cutte and made of stone very artificially," as George Best in 1578 described the Eskimos' soapstone cooking pots shaped like miniature sarcophagi.

As long as hunting was good, oil for the Eskimos' lamps was never a problem. Since the Eskimos consumed about six parts of meat to one part of fat, seals and whales provided much more fat than the people and their sled dogs could possibly eat, and the surplus fueled the lamps. Fire was not a problem either. The Eskimos had both the fire drill, a device that produced fire by friction, and firestones, iron pyrites which were struck together to create sparks. With either method, they used as tinder the slightly oiled down of willow catkins upon a bed of dry moss. It rarely took more than three to five minutes to kindle a flame.

In those parts of the north where whales and, hence, whalebones were rare and driftwood was equally scarce, the Eskimos built their winter homes of



An Eskimo woman watches over her child in a summer tent. Living in tents and igloos has become uncommon throughout the Arctic as most Eskimos have moved into permanent, year-round housing.

snow. In their language, snow, depending upon its type and consistency, has more than a hundred names, and it once had many uses. Absorbent, though cold, it was used in lieu of toilet paper. Ingenious traps were built with snow and baited with urine to capture caribou. A windscreen of snow blocks protected the fisherman jigging for lake trout or char. And *oqaalugsait*, hard-packed, fine-grained snow deposited unlayered by a single storm, was perfect for building the igloo, that emblem of Eskimo culture and ingenuity, which according to Richard L. Handy of the Engineering Institute of the University of Iowa, has "a structural perfection . . . matched but hardly surpassed by modern engineering."

A long, thin probe of caribou antler with an ovoid ferrule at one end and a handle at the other was used to find suitable igloo snow. Then blocks, each roughly three to four feet long, two feet high, and six inches thick, were cut with a snow knife made of bone, ivory, or native copper. Men built the circular igloo, spiraling the snow blocks upward, with each successive tier canted slightly more inward to achieve a perfect dome so strong it could easily support the weight of an adult person. It took less than an hour to build a small igloo, used as a temporary shelter while traveling, and two to three hours to build the large winter home, fifteen feet in diameter and seven feet high, that would house an entire family. A pane of freshwater ice set into the igloo's south or east wall served as a window, and an upward-sloping entrance tunnel of snow blocks formed the essential cold trap that prevented the escape of warm air from the building.

The myriad air cells within the snow made it an excellent insulator. Just the body warmth of its inhabitants could raise the igloo's temperature by about forty degrees above that of the outside air. The igloo had, however, one major failing: heated with oil lamps to more than 42°, it began to melt and drip. Thus an ordinary igloo, although windproof and reasonably comfortable, was hardly cozy. But many all-winter igloos were lined with sealskins, leaving a cold-air space between the lining and the snow walls, and in such homes the temperature could be kept between 60° and 70°. In late spring, the sun-warmed igloos sagged and became uncomfortably dank, necessitating a move into tents made of seal or caribou skins.

As vital as their winter homes, which permitted them to live in reasonable comfort in an icy land, and just as ingenious, was the Eskimos' winter clothing, so perfect in design and material it made them nearly impervious to any arctic weather. Furless and extremely vulnerable to cold, Eskimos protected their bodies with the skins of the superbly cold adapted animals of the north. Musk oxen, cloaked in dense fur so long it hangs nearly to the ground, can endure, with little heat loss, storms of seventy miles per hour and temperatures of −50°. The long guard hairs and dense fur of arctic foxes protect them so well that they do not have to increase their metabolic rate until the temperature falls below −40°. The fur most important for the Eskimos, virtually the sine qua non of their survival in the Arctic, was that of the caribou. Caribou hairs are club shaped, thicker at the tips than at their base, so that they trap body warmth in tiny air spaces near the skin;

and each hair is filled with air cells. The fur is short but very warm; the skin is light but very strong.

The Eskimos made every effort to kill caribou for winter clothing (and for food) in August and early September when the fur is of optimum quality. Seven skins were required to dress a man, six for a woman, and four for a child. The skins were carefully cleaned of meat and fat, and laid hair-down upon pebbly ground to dry as quickly as possible. Once dry, the skins were scraped with several different types of bone or stone scrapers—a hard and tedious task shared by men and women—until they were as soft as chamois leather. An experienced Eskimo seamstress could take the measure of her man at a glance, cut the required patterns from the skins with her *ulu*, the half-moon-shaped woman's knife, then sew the pieces together with closely spaced, overcast stitches. Dried caribou (or narwhal or beluga whale) sinew was her thread, ideal because it is very strong and molds itself to leather but does not tear it. Her thimble was made of musk ox horn or of depilated bearded seal leather; her needle of the hard wing bone of a gull or goose.

A complete winter outfit consisted of an inner parka worn with the hair against the body, an outer parka worn fur-out, inner and outer pants worn in the same manner, fur stockings, boots, and mittens. Wolverine fur (or that of wolf or dog) was used for the ruff of the loose-fitting parka hood because hoarfrost formed by breath could easily be brushed from it. Stockings were made of caribou fur or the down-soft fur of arctic hare; the boot sole from extremely strong, stiff bearded seal leather; the upper portion of the boot of ringed seal leather. A layer of dried grass, usually replaced each day, was put into the boot to form an insole that provided extra insulation and absorbed moisture. Mittens were made of caribou skin, often with a palm inset of durable seal leather. The entire outfit weighed just above ten pounds. It was loose and airy enough to avoid sweating, yet warm enough to enable a hunter, as the Danish ethnologist Knud Rasmussen observed, to stand "motionless as a statue" above a seal's breathing hole "in a storm and in a temperature of about −50°C." One man, Rasmussen reported, stood thus for two days and two nights, tired but warm in his superlative clothing. "When an Eskimo is well dressed," said Stefansson, "his two layers of fur clothing imprison the body heat so effectively that the air in actual contact with the skin is always at the temperature of a tropical summer."

Aglow from the light of oil lamps, an igloo is a winter haven for its inhabitants. The air cells within the snow are excellent insulation, and the residents' body heat is all that is needed to raise the temperature inside the igloo 40 degrees above that of the outside air.

In a few places, caribou were not available and the Eskimos had to make their winter clothes of other materials. On the Belcher Islands in Hudson Bay, adverse weather killed all the caribou in the 1880s, and the people made their parkas of eider skins—light, warm, but fragile. The Polar Eskimos of northwest Greenland traditionally wore pants of polar bear fur, extremely warm and durable, but somewhat hard and heavy. In this region, too, caribou had died out and the Eskimos made their inner parkas of bird skins (dovekies or murres) and their outer parkas of the skins of arctic foxes.

Whatever the material, one thing was essential: the clothes had to be perfectly dry or they lost their insulating quality. At the entrance to each winter home stood an *anowtaq*, a snow beater of bone or wood, with which Eskimos brushed and beat all snow from their clothes before entering. The outer layers of clothing were left in a cold, dry anteroom igloo, or chamber, and socks, boots, and mittens were carefully dried each night on a webbed drying rack suspended above a seal oil lamp.

The Eskimos did not relish cold. Heaven, they told the explorer Charles Francis Hall on Baffin Island in 1862, was a place of eternal light and warmth. And their vision of hell, as explained to Hall, was even chillier and gloomier than the mist-shrouded Niflheim of the Norse: "Always dark. . . . No sun . . . snow flying all the time, terrible storms; cold, very cold; and a great deal of ice there." Although they did not like the coldness of their land, they did not fear it either. Cold was a nuisance rather than a threat. Their superb cold-adapted culture shielded them from its lethal sting. □



Enduring Cold the Japanese Way

In Japan, people warm themselves, not their drafty houses

by Amanda Mayer Stinchecum

"A house should be built with the summer in mind. In winter it is possible to live anywhere, but a badly made house is unbearable when it gets hot." These words, written by the Buddhist priest Yoshida Kenkō in the fourteenth century, still reflect the feelings of the Japanese people. Lady Lawson, a traveler to Japan in the early twentieth century who, being English, was used to cold, damp winters, wrote of the Japanese house in winter:

> I believe the Japanese love to sit in draughts. On a cold, frosty morning, a paper house does not seem the right thing in the right place, and paper windows are inadequate, as the shivering foreigner feels. On these occasions, I used to recall Pierre Loti's dictum, that Japan was a tropical country which had moved up north by mistake and had never found it out.

It would be risky to state that the Japanese do not feel the cold as keenly as Westerners do, but there is no question that they are more stoic. Edward Sylvester Morse, who went to Japan in the late 1870s as a marine zoologist and became fascinated with Japanese culture, described his experience in Tokyo:

> Occasional snowstorms have occurred this winter but the jinrikisha men do not seem to mind the snow and run in it barefooted, and when standing the steam is seen rising from their bare feet. Curiously enough, the houses appear as open as in the summer. The children are barelegged, just as in the summer, and play in the snow without minding the cold.

In general, instead of seeking to change an uncomfortable or difficult situation, the Japanese accommodate themselves to it or, more often, endure it so as not to make anyone else uncomfortable. They frequently speak of the necessity of putting up with things or being resigned to them. This attitude of accommodation is perhaps at the root of the Japanese approach to dealing with cold: they warm themselves, their individual bodies, rather than their environment. And this, in turn, is tied to the way they think of the space they inhabit.

The traditional Japanese house and garden form an integral unit, separated by a wall from the surrounding community and from raw nature. The garden usually lies on the south side of the house, although its shape varies as part of the overall design. Particularly in smaller towns and in the country, the garden may adjoin rice fields, vegetable gardens, or even uncultivated land, and the wall surrounding it and the house may be simply a living hedge of bamboo or other foliage. Nevertheless, the garden is not part of nature but a reconstruction of it that belongs to the space of the house. It is not a backyard to sit out in on hot summer nights, but a setting for seasonal changes to be viewed in safety from one's living room. In order to appreciate the poignancy of the passing seasons, the Japanese observe the garden, even in winter, not through narrow panes of glass, but with the sliding doors thrown open as wide as possible. In her *Pillow Book*, Sei Shōnagon, the great diarist and wit of Japan's early eleventh-century court, described with delicacy a typical scene at the palace in Kyoto:

> In winter the early mornings [are loveliest]. It is beautiful indeed when snow has fallen during the night, but splendid too when the ground is white with frost; or even when there is no snow or frost, but it is simply very cold and the attendants hurry from room to room stirring up the fires and bringing charcoal, how well this fits the season's mood! But as noon approaches and the cold wears off, no one bothers to keep the braziers alight, and soon nothing remains but piles of white ashes.

As one might guess, the inhabitants of Kyoto do not face winters of extreme cold. The four main islands of the Japanese archipelago extend south to north as far as the United States does from Mobile, Alabama, to Bangor, Maine, but more than two-thirds of Japan's population lives in temperate regions south of the thirty-sixth parallel. Japan's major metropolitan centers are concentrated between 35° and 36° north latitude, the same as the central third of the state of North Carolina. In this zone, temperatures in January average 32° to 39°F, and people who live in such cities as Tokyo, Nagoya, Kyoto, and Osaka may see snow only once or twice a year. Even in the northernmost and more mountainous regions of the main island of Honshu, the January temperatures, warmed by the Japan Current (*Kuroshio*), average from 18° to 32°.

Hokkaido, the most northern of Japan's main islands—and the coldest—is a case apart. Originally inhabited by the Ainu, a racially and culturally distinct people, Hokkaido did not have large numbers of Japanese settlers until the nineteenth century. In general, the architecture follows the European more than the Japanese tradition, and the life style also reflects the strong Western influence that followed the Meiji Restoration in 1868. Faced with snowy winters, the settlers of Hokkaido, by necessity, departed from the original Japanese patterns. A description of traditional attitudes does not apply to Japan's truly cold region, therefore, but to the more characteristic temperate areas, where nevertheless, the dampness of the climate, combined with features of Japanese architecture that preclude efficient heating, contributes to an experience of winter that can be uncomfortably cold for weeks or months on end.

The traditional Japanese house is un-

A woman wears a straw cape for protection in snowy Niigata, a prefecture on the northwest coast of Japan's main island, Honshu. Underneath, she wears her ordinary house clothes and no gloves.

Kazuyoshi Nomachi; Pacific Preas





The traditional Japanese house remains open to a south garden the year round. The overhanging eaves shade the house in summer; in winter, the sun rises and sets more to the south, shining into the house.

Bruno Zehnder

suited for heating not only because of its integration with the garden but also because of its construction. Like the modern skyscraper, it is supported by its frame. The exterior walls serve mainly to enclose the space, block the wind, and give a sense of privacy. Sliding doors of paper or glass often constitute one entire side of the house, sometimes more, depending on how extensive the garden is. These provide no insulation from the cold, and the *amado* (storm doors) that are drawn across at night or during heavy storms are only made of a single layer of wood or thin aluminum. Inside, the rooms are small and the ceilings are low, helping somewhat to retain heat. But the walls of the rooms consist of *fusuma* (opaque sliding screens), which are flimsy and light and can be lifted out of their grooves to open up the interior space. Between the top of the *fusuma* and the ceiling there is often a wood or bamboo latticework transom, which is intended to aid ventilation and cannot be closed to conserve heat.

The traditional house is designed for winter in only one way: it is built with maximum southern exposure. Usually the best room in the house faces south, where the garden is located. In a well-designed house, the overhang of the roof is sufficiently long on this side to block the rays of the summer sun. On sunny days in midwinter, the doors are thrown open to let in the sunshine and air the house, and the bedding is hung from an upper balcony railing to air it and warm it up for the cold night ahead.

The Japanese have traditionally used charcoal fires for heat, but these mainly warm individual bodies rather than the space surrounding them. There are three types of arrangements for burning charcoal. The most basic is the *ro* (fire-pit or hearth), a square or rectangular pit framed with heavy timbers and lined with stone or brick, which is built into the tatami-covered floor. The *ro* is not usually seen in city houses, except in the tea room if there is one; it is more prevalent in rural areas, where wood may be burned instead of charcoal. The *ro* is used for heating water for tea, for warming the hands, and for cooking certain one-pot meals, but not for cooking regular meals; for this task, there is a separate cooking stove, often in another area of the house. The fire in the *ro* is kept low, and because the ceiling above it is often left open to the rafters to allow the smoke to escape, its capacity to heat interior space is limited.

The *kotatsu* is the most effective heating device and is still widely used, although not in its charcoal-burning form. It originated as a wooden frame set over the *ro* and covered with a quilt to keep the heat from escaping. Feet and legs were pushed under the quilt, warming the lower half of the body. A more elaborate arrangement is the *hori-kotatsu*, or sunken *kotatsu*, a deep pit in the floor, usually in the main sitting room of the house. A wooden grating is set over the burning coals of the *hori-kotatsu* and over the whole pit is placed a low table covered with a quilt. People sit around the table Western-style, that is, with their legs hanging down into the pit, and cover themselves from the waist down with the quilt. For meals and other activities requiring a hard surface, a separate tabletop is set over the quilt. Some traditional houses, even recently built ones, still have *hori-kotatsu*, but these are usually electrically heated. The common modern adaptation of the *kotatsu* is a low table frame with an electric heating element attached to the underside; the quilt is placed over this, and then a tabletop (usually of Formica, although in an elegant house it may be made of beautifully finished wood).

The third of the charcoal-burning devices is the hibachi, a brazier or firebox, which bears little resemblance to the grill Americans use to cook meat outdoors. Made of pottery or of wood lined with copper, this device is used for burning a few small pieces of charcoal on a bed of finely sifted ashes. The hibachi is designed primarily to warm the hands or to heat water for tea. Old woodblock prints frequently depict its use in a room open to a snowy garden. Before the introduction of electric, gas, and kerosene heating stoves, the hibachi was often the only source of heat in a city dwelling. Morse remarked on his own quarters in Tokyo:

> My only stove is a square wooden box in which is a round earthen vessel filled with ashes. . . . Ice has already formed outside and my room would be very cold without the little charcoal fire. I have become accustomed to the carbonic gas, though most of it settles through the cracks of the floor; when it gets too strong, I open the door. On enquiry I found that the Japanese never suffer any inconvenience from burning charcoal, their sole means of heating. The old woman who . . . brings in a few hot coals from her own hibachi had never heard of the gas being injurious, nor had she an idea that it could kill one.

The cost of charcoal has risen so high, however, that the charcoal-burning hibachi has all but disappeared: it is now a luxury reserved for such gracious pursuits as the tea ceremony. Gradually, kerosene, gas, and electricity have replaced the traditional fuel. Believed to present less danger of conflagration,

electricity and gas were preferred until the recent "oil shock," when the cost rose so dramatically that many Japanese switched to kerosene. Some of the new fixtures—usually small, portable stoves—are space heaters. Because of the unpleasant fumes from both gas and kerosene, however, such stoves are used only intermittently, and not at night, when the house is more tightly closed off by the storm shutters. In general, fires are not left burning unattended, or at least not with sufficient heat to keep a room warm. On a frosty night, bedding remains the primary retreat from the cold.

Japanese bedding, called *futon*, consists of a set of mats and quilts filled with cotton batting or silk floss. An underpad is spread first, then one or more top quilts, depending on the degree of cold. In the West, people often cling together in bed for warmth in the winter, but in Japan most adults sleep in individual beds. The *futon* are likely to be placed immediately adjacent to one another, however, because in Japan sleeping is a social activity. The members of a household and their guests usually sleep together in a few rooms, rather than spreading out one to a room, even where the size of the house permits it. And up to the age of six or seven, children often sleep in their mother's beds. These sleeping customs, however, seem to derive from a need for security rather than warmth.

In addition to the bedding itself, there are a number of devices to warm up a cold bed. One is the hot-water bottle, dear to English hearts, but in Japan it is made of metal or ceramic instead of rubber. Morse also describes "a little wooden box . . . used for the purpose of holding an earthen receptacle for coals, and this is taken to bed as a substitute for the hot stone or brick which is often used at home for a similar purpose." Both of these have now generally been discarded in favor of the electric blanket; the type that is spread under the sleeper seems to be preferred to the kind that is used as a cover. Sometimes the bedding is placed over or around an electric *kotatsu*, the low table with an electric heating element attached to the underside. Sleepers lie with their feet under the table, and the whole bed is warmed. This is considered a dangerous arrangement, however.

As bedding is used at night, so clothing is used by day to conserve body heat and keep the individual warm. One item, the *dotera*, or *tanzen*, is actually a cross between a kimono and a *futon*, that is, between a garment and bedding. A heavily padded, oversized kimono with wide sleeves, it can be drawn around the body or spread over the bedding for extra warmth.

The traditional layers of clothing include, for a woman, a *koshimaki* (wrapped underskirt) or *nagajuban* (underkimono), two or more of which are worn in cold weather. Over these a woman wears a kimono and either a *haori* (jacket) or *hanten* (padded jacket). The *hanten*, which is less formal than the *haori*, is available in a version large enough to cover an infant carried on its mother's back. A man would wear long underwear, and his kimono would be padded or would be covered by a sleeveless vest.

This use of layers of clothing is a practical solution to the problem of cold in a culture in which people do not traditionally wear either furs or fleece. Because Buddhism prohibits the killing of animals, the use of furs never became widespread in Japan, although now they are sought as a Western-style luxury item. And because sheep were not a part of the rural household, wool was not available for winter clothing until relatively recently. Before industrialization, Japan was an agrarian society in which domestic animals did not play a major role. Rice was cultivated by human labor, and meat was rarely eaten until the custom was introduced from the West in the sixteenth century.

Traditionally, farmers and poorer urban classes wore hemp cloth year-round, while the wealthier classes wore clothing padded with silk floss. The cultivation



While watching television, a family keeps warm under the quilt of their kotatsu, *a low table with an electric heating element underneath. Enclosed by opaque* fusuma *and white paper shoji screens, the room itself is unheated.*

John Launois, Black Star

and production of cotton, introduced into Japan by the late sixteenth century, became widespread during the eighteenth. Cotton was found to be much warmer than hemp and soon became the preferred material, thickened in various ways to make it warmer. Both adults and children wore kimonos and jackets padded with cotton batting. To give garments added strength and warmth, a quilting stitch, called *sashiko*, could be used either on a single layer of cloth or to join two or more layers of cotton. In northern Japan, where the climate precluded the cultivation of cotton, the people made cotton cloth from used kimonos or rags. They tore these into strips and wove the strips together into a heavier and more durable cloth. In Japan today, those who wear Japanese-style clothes have the advantage of wool kimonos; they may also wear shawls over their kimonos and, underneath, long underwear and sweaters.

The Japanese once made use of paper clothing, or *kamiko*, which was originally worn by Buddhist priests (since paper garments could be seamed with paste, no woman had to touch them). By the end of the seventeenth century, *kamiko* were also worn by ordinary people, especially to ward off the cold on journeys. The paper was coated with persimmon tannin to make it strong and waterproof. The seventeenth-century haiku poet Matsuo Bashō mentions carrying a *kamiko* when he started off on his journey to the far north: "Setting out with nothing but what I could bear myself, I carried a stout paper raincoat to keep out the chill at night."

Various kinds of rushes and rice straw were once used for raincoats, footwear, and hats. Besides being water-repellent, the hollow straws provided some insulation against the cold. In rural areas, sedge hats are still worn as protection against sun, rain, and snow. In earlier periods the Japanese wore many kinds of hats as signs of rank and for protection in battle or against the elements, and hoods were worn for warmth by women, old men, and priests (who shaved their heads). But today the Japanese rarely wear hats except to shade themselves from the sun or to keep off precipitation. While Westerners concentrate on keeping their extremities warm, donning hats, scarfs, gloves, and warm socks when the weather turns chilly, the Japanese seem unconcerned about such items of clothing.

Japanese tradition places the seat of a person's being—the spirit, the emotions, the breath—in the belly (*hara*): if the belly is kept warm, the person will be warm and healthy. The *haramaki*, or belly band, often a knitted wool tube about six inches wide, keeps the abdomen warm. Once more common, *haramaki* are worn today primarily by workmen who are exposed to the cold, by pregnant women, and by children. In fact, *haramaki* are built into children's pajamas. Another device for heating the belly or chest, used since the beginning of the eighteenth century, is the *kairo*, a small container filled with smoldering ashes, which is worn tucked under the sash or into the folds of the kimono. In earlier periods, a heated pumice stone wrapped in rags was similarly used.

The Japanese warm their insides as well. In winter they drink hot tea, of which there are many types, almost continuously. The tea not only warms the middle, but the handleless teacup warms the hands as well. And while all cultures with cold winters have their own special hot drinks for cold nights,



Paul Chesley, Aspen

In winter, women at a hot spring resort in Beppu, on the island of Kyushu, are comfortable in light clothing and bare feet. The unlined striped cotton kimono, hanten *jacket, and wooden clogs are issued by their inn.*

Family members as well as strangers share the bath at a country inn, soaking in the hot water after washing themselves outside the tub. Often a social occasion, the bath is a favored way to relax and get warm.

John Launois, Black Star



the Japanese heat their rice wine, sake, in all but the hot, summer season. In Japan, drinking liquor is a social activity—pouring one's own drink is considered inappropriate.

Meals also take on a more communal quality in the winter, creating more warmth in a room. A special category of dishes, called *nabemono*, or one-pot meals are prepared at the dining table. Into a pot of boiling broth, the hostess plunges various combinations of vegetables, fish, chicken, and meat. When these are just barely cooked, each diner fishes out a portion and dips it into an individual bowl of sauce. Sukiyaki, an American favorite, is a *nabemono* dish. This type of cooking originated in the rural and the more northern areas of Japan where the open hearth was a common feature of domestic architecture. On a cold night, the heating element—originally the *ro* but now a gas burner or electric ring—and the simmering broth warm the people huddled around the table. Other hot foods prepared in winter include noodles served in steaming broth, and sweetened bean paste, thinned to the consistency of a thick soup and served with pieces of rice cake in it.

The one place where the Japanese can feel totally surrounded by warmth, however, is the bath. It is the best way to relax before going to sleep, and a long soak in the near-scalding water warms the body for hours afterward. For the Japanese, who are more oriented toward the group than are Westerners, the bath is, more often than not, a social activity as well. The public bath provides an occasion for social relaxation and gossip. In cities and small towns, there is always one, often two, within walking distance of most households. Many Japanese who live in apartments or boardinghouses, such as students and unmarried men, do not have their own baths, while in some older houses the large tub must still be heated by building a wood fire under it. Even when a gas flame is used, preparing the bath at home is time-consuming (as well as costly). At the public bath, on the other hand, for a modest fee there are unlimited quantities of hot water and, in Tokyo and Kyoto at least, sometimes whirlpool baths and saunas. Cold beer, milk, and soft drinks are available in the changing rooms, the television is tuned to the most popular melodramas or the evening's baseball game, there is the opportunity to visit with one's neighbors and friends, and someone else cleans up.

An extension of the amenities offered by the public bath can be found at the numerous hot spring resorts scattered throughout Japan. Hot springs are more popular during the warmer seasons, but to spend New Year's at a hot spring is one of the delights of winter travel in Japan. Guests spend hours in the pools, indoors and out, sipping cups of tea or sake while they soak.

The Japanese have turned in recent years to methods of heating the environment rather than warming individual bodies: they are beginning to install central heating in newly built apartment houses and even in single-family homes. Mainly because of the rising cost of fuel, however, this is still the exception rather than the rule. Ingrained attitudes toward enduring the cold and enjoying the natural beauties of the winter season, longstanding architectural customs, and the energy crisis all contribute to the retention in Japan of a traditional approach to keeping warm. □

ACTUAL SIZE OF PLATES IS A FULL 9¼"

The Refanu





The Flying Dutchman



The Pride

Affordable beauty to treasure forever...

Legendary Ships of the Seas

The ten great sailing vessels of history and legend... captured forever on limited-edition porcelain art plates.

Examine the first legendary ship, "The Flying Dutchman," for 15 days without risk.

Strict Edition Limit: 19,500 worldwide
Your Reservation should be mailed by November 30, 1981.

A love of the sea lies deep in the hearts of us all. We often imagine ourselves sailing away on a romantic clipper into a golden sunset... enjoying a life of leisure on a fabled pleasure ship...living out the adventurous tales of the sea.

Now, from the renowned house of Royal Cornwall®, Ltd. and the brush of acclaimed artist Alan D'Estrehan come the *Legendary Ships of the Seas:* 10 magnificent sailing ships captured for eternity on exquisite porcelain.

Relive these ageless stories of the most celebrated sailing ships of fact and fantasy. From the giant paradise vessel "The Refanu," whose towering masts must be lowered for the ship to pass under the sun and moon ... to "The Pride," the romantic brigantine of pirate Jean Laffite, still seen gliding through the waters of Galveston Bay... here are the most vivid portraits of sailing ships ever created on porcelain, a collection of beauty and romance to grace your home and enrich your life forever.

The premier plate series by renowned artist Alan D'Estrehan

The magnificent paintings for this series are the creations of award-winning artist Alan D'Estrehan. A descendant of John Singer Sargent, one of America's most renowned painters, D'Estrehan carries on the same tradition of impeccable artistry that is the hallmark of his famed relative. Widely exhibited and critically praised throughout Europe and America, D'Estrehan debuts in the collector's plate field in brilliant fashion with *Legendary Ships of the Seas*.

With his intense passion for the sea and his rare artistic ability, Alan D'Estrehan was the perfect choice to create the paintings for this series. In order to capture the very essence of these legendary ships, D'Estrehan spent two years studying the log books of ancient ships and poring through the actual eyewitness accounts. The result of his labor and talent is a limited-edition art collection that vividly and accurately captures the lure of the sea and the authentic details of the famous ships of legend.

Affordable beauty for your home

Imagine all 10 *Legendary Ships of the Seas* proudly arranged on your bookshelves, or gracing your walls in an eye-catching array of colors. From the vibrant scarlets of the banners in Queen Anne's flagship "The Gaspé Bay"...to the icy silver and blue of the phantom vessel "The Rescue," every shade and hue glows from the gleaming surface of the fine Royal Cornwall porcelain.

Despite all the care and craftsmanship lavished on each of the plates, *Legendary Ships of the Seas* represents an easily affordable collecting opportunity. The cost for each fine plate in the collection, measuring a full 9¼ inches in diameter and banded in a ring of shimmering 24 karat gold, is only $49.50, to be billed in two equal installments for your convenience. The plates will be sent one every other month.

To be guaranteed acceptance, please reply no later than November 30, 1981

Examine the first plate, "The Flying Dutchman," for 15 days. Relive the haunting tale of the ship's captain, a man fated to sail the seas forever, unless he can find a pure maiden who will love him with all her heart. If "The Flying Dutchman" fails to please, simply return it for a full refund or charge-card credit and you will be under no further obligation.

Included with each plate is a Certificate of Authenticity bearing the plate's registered number within the limited edition. Your number remains the same through all 10 plates, giving your set the highly desirable distinction of a perfectly matched collection.

Legendary Ships of the Seas marks a major collecting opportunity worth your serious consideration, for several reasons:

- The enduring theme of nautical art has traditionally been among the most popular subject matters in the history of limited-edition plates.
- *Legendary Ships of the Seas* brings the illustrious naval artist Alan D'Estrehan into the plate collector's field for the first time. "Firsts" historically spell profitability for collectors.
- The enduring value of this collection is assured by its strict edition limit. Once the limit of 19,500 has been reached, the collection will be closed forever.
- Finally, and perhaps most important, the great art itself is gallery quality. Ten beautiful ships come alive in the masterful artistry of Alan D'Estrehan.

Your *Legendary Ships of the Seas* will make an heirloom collection you can be proud to own and display, and even prouder to pass down to future generations.

The backstamp attests to each plate's authenticity at the time of any future resale.

The artist's signature



The number of the plate within the limited edition inscribed in gold

CALHOUN'S COLLECTORS SOCIETY
7275 Bush Lake Rd. • P.O. Box 1218
Minneapolis, Minnesota 55440

SUBSCRIPTION RESERVATION
Please mail by November 30, 1981

CALHOUN'S COLLECTORS SOCIETY
7275 Bush Lake Rd. • P.O. Box 1218
Minneapolis, Minnesota 55440

☐ Please enter my Reservation for the *Legendary Ships of the Seas* collector plate series. The cost for each plate in the series, including postage and handling, is two equal monthly installments of $26*. Before my first plate is ready to be shipped, you will contact me concerning the payment plan I prefer. If I am not completely satisfied with my first plate, I may return it within 15 days for a full refund of the amount I have paid.

NAME_____

ADDRESS _____

CITY_____

STATE _____ ZIP_____

*Minnesota residents add 5% ($1.24) sales tax for each installment.

© 1981 Calhoun's Collectors Society, Inc.

Shivering Finches

For some small birds that don't fly south for the winter, extra fat and shivering may boost their chances for survival

by Cynthia Carey and Richard L. Marsh

Chilled to the bone by the cold wind as we skiied through the woods one snowy day in Michigan, we were looking forward to a cup of hot chocolate and a warm fireplace. Rounding a bend in the trail, we were surprised to see a flock of small birds noisily foraging in bushes blown free of snow. We knew that most avian species that breed in arctic and temperate climates migrate to warmer areas for the winter and that only a few hardy species remain all year as permanent residents. Migratory birds possess orientational, behavioral, and physiological traits that enable them to migrate successfully, and we wondered what kinds of adaptations enabled resident birds to survive cold winters.

In many respects, the problems associated with staying warm in cold climates are similar for birds and mammals, such as humans. Both birds and humans maintain high body temperatures (104° and 98.6°F, respectively) by internal production of heat. Such heat production is sufficiently great that body temperatures are raised above external air temperatures, somewhat as a furnace heats a house above the outside temperature in winter. The temperature inside the house is maintained at a comfortable and constant level by a thermostat, which turns the furnace on and off. Colder air temperatures increase the rate of heat loss from the house and require the furnace to produce heat for longer periods of time than milder temperatures do.

Animals, however, produce heat, and regulate heat production, by methods different from that of a furnace. All living things produce heat by releasing energy stored in the chemical bonds in their food, specifically in carbohydrates, lipids, and proteins. Some of this energy is temporarily stored in the high-energy bonds of adenosine triphosphate (ATP) molecules, which can then be used as the energy source for all the cellular and physiological functions necessary for life, such as ion transport across membranes, synthesis of cellular components, and contraction of heart and skeletal muscle. The transfer of energy from the chemical bonds in the foodstuffs to ATP is not very efficient: about 60 percent of the energy is lost immediately as heat. Furthermore, as ATP is used for various metabolic functions, all the energy in the original foodstuff ultimately becomes heat energy. Since the production of ATP requires oxygen and produces carbon dioxide, physiologists usually estimate heat production by measuring the amount of oxygen consumed or carbon dioxide released by an organism.

Animals, unlike furnaces, do not periodically turn off their heat-producing mechanisms. Maintenance of living tissue requires continual production of ATP, which constantly generates heat. The minimal level of metabolic processes needed to maintain life, called the basal metabolic rate, produces enough heat to maintain a 98.6° body temperature in a nude human at air temperatures down to about 73.4°. If air temperatures fall below that level, the maintenance of constant body temperature requires additional heat, which both humans and birds produce by shivering. During shivering, antagonistic muscles contract simultaneously, so no external work is done. Thus, all of the energy used in contraction appears as heat inside the body. The principal compounds supplying the energy in the muscles are glycogen (the storage form of glucose) and triglycerides (lipids composed of fatty acids and glycerol). In severe cold, shivering can elevate the metabolic rate as much as five times above the basal level.

Cold-climate birds, the majority of which are diurnal, have a large requirement for food to fuel the costs of shivering. The short periods of daylight in northern latitudes, however, reduce the amount of time for foraging, and inclement weather, snow cover, or ice may further restrict food availability. The problems of staying warm must be particularly intense for small birds weighing less than thirty grams. Because small birds have a large surface area relative to their volume, their problems of heat loss are relatively more severe than those of larger birds. Smaller birds are also relatively less insulated than larger ones since their size limits the thickness of the insulative layer. Finally, calculations by William A. Calder of the University of Arizona suggest that larger birds can endure fasting under cold stress for longer periods of time than smaller ones.

The problems encountered by small birds in cold climates have stimulated considerable research during the past thirty years, most notably by the late J. Stanford Hart of the National Research Council of Canada, George C. West of the University of Alaska, and William R. Dawson of the University of Michigan. Their efforts and the work of others have established that wild birds use a combination of two general means to cope with cold: mechanisms that reduce the amount of heat required to maintain a high body temperature and mechanisms that allow high levels of heat production for long periods of time.

One of the ways birds can reduce the amount of heat they must generate in the cold is by increasing their insulation, an advantage that should be obvious to anyone who has put on a down jacket on a cold winter day. Extra feathers reduce the rate of heat loss and the requirement for additional heat production. Since the thickness of plumage is limited in small birds, larger birds can utilize seasonal variation in plumage insulation more extensively. The plumage of a 550- to 650-gram willow ptarmigan (*Lagopus lagopus*) in Alaska, for example, varies seasonally not only in color—from brown in summer to white in winter—but also in insulative value. Because of the difference in insulation, the heat

To maintain normal body temperatures in the winter, goldfinches and other small birds produce heat by shivering. Some birds also adapt to cold by growing additional feathers or seeking protected roosts.

Larry West; Bruca Colaman



production required for the ptarmigan to maintain a high body temperature is the same at 32° in summer as it is at −13° in winter.

Many small birds wintering in cold climates also appear to reduce their heat-production requirement by seeking protected roosts in dense vegetation, crevices in snow, or cavities in rocks or trees. These roosts protect against direct exposure to precipitation and the chilling effects of wind, and they reduce radiant heat losses to the night sky. S. Charles Kendeigh of the University of Illinois noted that the body heat lost by house sparrows (*Passer domesticus*) in wooden roost boxes warmed the air inside the box and contributed to a substantial energy saving during the night. Observations by Brina Kessel of the University of Alaska of the activity of chickadees (*Parus atricapillus*) in Alaska suggested that these birds remained in their roosts for longer periods during the daylight hours and foraged for shorter periods during cold spells (at temperatures of about −58°) than on milder days. This behavior would reduce the high heat losses incurred by the movement of plumage during flight, thereby conserving energy reserves.

In addition, some small birds, most notably chickadees, may not expend the necessary energy to maintain high body temperatures at night. Susan Chaplin of Cornell University found that body temperatures of chickadees exposed to 32° in the laboratory dropped eighteen to twenty-two degrees during the night. This nocturnal reduction in body temperature—known as hypothermia—is a normal phenomenon from which the birds recover spontaneously the next morning. If it occurs under natural conditions in the field, hypothermia can save the birds up to 23 percent of the estimated energy required to maintain normal temperatures.

Although small birds may use increased insulation, protected roosts, and/or nocturnal hypothermia to reduce the requirements for heat production and husband their energy resources in winter, they must also be able to sustain high levels of heat production for long periods. We believe that they probably shiver continuously all winter except during periods of flight, when muscle contractions associated with flying also produce heat substantially above basal levels. The general question of how small birds produce high levels of heat for long periods has not received much attention, and it was this area that excited our curiosity on our cross-country ski trip.

Our interests coincided with the research of William R. Dawson, who was then our professor at the University of Michigan and who has spent nearly twenty years investigating avian metabolic adaptations to cold climates. Joining forces with him in an attempt to discover more about the heat-generating capacities of birds, we selected the subfamily Carduelinae, which includes goldfinches, house finches, pine siskins, crossbills, redpolls, and pine grosbeaks, for our studies. The cardueline finches are ideal for our purposes since the majority weigh less than 30 grams, the geographical distributions of many species are primarily northern, or boreal, and populations of many species are year-round residents in cold climates.

American goldfinches (*Carduelis tristis*), the first subjects of our study, weigh 12 to 15 grams and are widely distributed throughout North America. The winter distribution of the eastern subspecies extends northward into southern Canada, but some individuals may migrate into the southern states in winter. Banding records accumulated by the U.S. Fish and Wildlife Service indicate that members of the local population in southern Michigan, where we worked extensively, may remain in the area all year. Interestingly, however, individuals may migrate in some years and not in others: a bird banded in Alabama one winter was recovered in Michigan the following January.

Our first goal was to characterize the thermogenic, or heat-generating, capacities of goldfinches. In our experiment, both temperature and time were factors, since the ability to produce large amounts of heat and to sustain this high level of thermogenesis is important for survival in the cold. We devised a chamber in which the temperature of the air surrounding the bird was lowered from approximately 32° to −94° over a period of an hour and a half. Although these birds probably never encounter such severe cold stress in nature, this technique elicited the desired large thermogenic response. We felt that the technique would also prove useful in comparisons of the thermogenic capacities of species or of individuals within the same species captured in various seasons; J.S. Hart had previously established that differences in the ability to withstand severe cold are demonstrably



correlated with differences in survival time at more moderate temperatures.

As the air temperatures in the chamber cooled, the goldfinches elevated their metabolic heat production, measured as oxygen consumption, to offset the progressively higher rate of heat loss. By the time the air temperatures fell to −94°, the birds were producing heat at about 5.5 times the basal level to maintain a gradient of approximately 198 degrees between body and air temperature. Individual birds were retained in the chamber as long as oxygen consumption rose or remained stable, which indicated heat production was adequate for maintenance of body temperature, and were removed from the chamber when oxygen consumption fell, indicating the birds were no longer able to sustain heat production.

When goldfinches captured in summer in southern Michigan were subjected to this test, they were able to withstand only a few minutes at temperatures below −76° before oxygen consumption dropped and they became severely hypothermic. In contrast, we were impressed to learn that the goldfinches trapped in winter could sustain necessary levels of heat production for six to eight hours below −76°. Sampling birds from our area of Michigan every month of the year we found that the seasonal variation in thermogenic ca-



Under experimental conditions, goldfinches captured in winter can endure more cold than those caught in summer. The difference is largely due to seasonal variation in the capacity to store and use metabolic fuels involved in heat production.

Michael J. Kopiak for the Cornell Laboratory of Ornithology

pacity correlated nicely with the prevalent weather conditions. Heat-generating capacities, measured in terms of both the maximum level of heat production and the ability to sustain thermogenesis, increased as ambient temperatures dropped in the late fall, reached their peak in January, and then declined in the early spring. Birds sampled in the warmer months of April through October exhibited only marginal abilities to cope with cold.

To investigate the mechanisms underlying the striking seasonal variation in thermogenic capacities in goldfinches, we looked for three types of physiological adjustments that might enhance these capacities in winter: an increase in the ability of the heat-generating tissues to utilize oxygen and to oxidize metabolic fuels for the production of ATP; an increase in the supply of triglyceride and glycogen to thermogenic tissues; and a seasonal shift in the relative importance of triglyceride and glycogen as fuels for shivering.

The pectoralis muscles of birds serve both as the major flight muscles and as the primary site of shivering thermogenesis. We first investigated whether the mass of these muscles varied seasonally since an increase could indicate a change in the total amount of thermogenic tissue. We found that the pectoralis masses, which make up 20 percent of the body mass, do not vary with the seasons. We then tested the oxidative ability of this muscle, that is, its ability to use oxygen to catabolize fuel. (Catabolism is a metabolic process involving the breakdown of the complex materials of living tissue and the release of energy.) An analysis of the activities of two enzymes in the tricarboxylic acid cycle—a metabolic pathway that requires oxygen and metabolic derivatives of either glycogen or triglyceride to produce ATP—did not show a seasonal change. The oxidative capacity of the goldfinch pectoralis muscles was, however, among the highest found in vertebrate muscle. We believe that the lack of seasonal variation in oxidative capacity or muscle mass in goldfinches can be explained by the basic characteristics of avian flight muscle. In some species, flight may require an elevation of metabolic rate to more than ten times the basal level. Therefore, the evolution of flight may have necessitated the development of pectoralis muscles with oxidative capacities that are not only adequate to sustain long flights but also ample for prolonged thermogenesis.

Our second area of exploration was the possibility that the seasonal change in thermogenic capacity was related to a yearly variation in availability and mobilization of fuels for shivering thermogenesis. We found that body masses of goldfinches fluctuated from 12 or 13 grams in summer to 15 or 16 grams in winter. The body component responsible for most of this variation was triglyceride, which ranged from less than 0.5 grams in summer to nearly 2 grams in winter. Laboratory tests confirmed that triglyceride was mobilized from storage depots and oxidized by the birds during cold stress, and the resultant decline in the triglyceride content of birds tested under conditions of severe cold (−94°) and moderate cold (14°) accounted for most of the heat production. The seasonal variation in the triglyceride content of goldfinches thus closely paralleled the yearly change in thermogenic capacity, evidence that the ability to store triglyceride and to mobilize it rapidly plays an important role in the success of goldfinches in cold climates.

Our studies of substrate utilization by shivering goldfinches clearly indicated, however, that the seasonal shift in triglyceride storage was not the only important factor determining endurance during cold stress. Goldfinches do have significant triglyceride reserves in summer, but in the −94° tests, they fail to use these reserves before going hypothermic. Most important, when goldfinches tested at −94° in winter do finally succumb to the cold, they still have considerable triglyceride reserves remaining in the storage depots. The failure to thermoregulate when triglyceride reserves appear adequate may be related to a complex series of hormonal and biochemical factors that influence mobilization, transport, and oxidation of fatty acids.

To understand further the role of fuels in limiting the thermogenic capacities of goldfinches, we turned to an examination of the use of carbohydrates by shivering muscles. Vertebrates normally store only a fraction of their total energy reserves as the carbohydrate glycogen. Glycogen has about one-half as much energy per gram as does triglyceride and, in addition, must be stored



dissolved in water. Triglyceride, in contrast, is hydrophobic and can be stored in an energy-dense form that minimizes its bulk.

Existing data on mammals (including humans) suggest that carbohydrate, although quantitatively less important than triglyceride, is the limiting fuel in conditions requiring a high rate of energy expenditure, such as exercise or cold stress. Although the exact mechanism causing muscle fatigue is not clearly understood, muscle exhaustion correlates with a depletion of glycogen reserves and/or a reduction in blood glucose, which is either derived from liver stores of glycogen or synthesized in the liver from other compounds, principally amino acids. People who jog or run recognize that fatigue sets in long before triglyceride reserves become exhausted; marathon runners usually attempt to prolong their endurance by "carbohydrate loading" before a race. It is also interesting to note that in humans subjected to cold stress, low blood glucose often leads to hypothermia.

Goldfinches captured in winter store approximately 11 to 25 milligrams of glycogen in the pectoralis muscles and liver, an amount representing only about one-hundredth the mass of triglyceride stores. When these birds were tested at moderately and severely cold temperatures, they removed less glucose from the blood and used less glycogen stored in the pectoralis muscles than summer birds tested under similar conditions. The endurance of these birds during cold stress may depend significantly on the ability to utilize the available carbohydrate at a lower rate in winter than in summer. We believe this ability results from an enhanced capacity to catabolize triglyceride in winter: the activity of the enzymes that break down fatty acids is 50 percent higher in the muscles of winter birds than in those of summer birds. The use of more triglyceride in the muscles may spare the limited carbohydrate for such essential functions as energy supply to the brain, which is principally dependent on blood glucose for energy.

Although the augmented capacity to store and use triglyceride and the decreased rate of carbohydrate breakdown appear to play important roles in the seasonal increase in thermogenic capacity in goldfinches, other metabolic factors may exist that we have not yet documented. It is important to remember, too, that these metabolic changes constitute only some of the methods by which goldfinches cope with cold winters. By slight increases in insulation and the use of protected nocturnal roosts, they also reduce the amount of heat production required to maintain body temperatures. William A. Buttemer, another graduate student working with Dawson, found that goldfinches roost among the branches of conifers during winters in southern Michigan. Measurements of the heat production necessary to maintain a high body temperature in these roosts indicate that the birds may conserve as much as 30 percent of the energy that would be required if they roosted in an unprotected spot. The success of goldfinches in cold climates is clearly due to a suite of metabolic, insulative, and behavioral adaptations.

As some features of the goldfinches seasonal adjustment to cold became apparent to us, we wondered whether this pattern was typical of other cardueline species. To address this question, we turned to house finches (*Carpodacus mexicanus*). These 18- to 21-gram birds have a more southerly distribution than goldfinches and are very common in the southwestern United States. Their distribution extends northward up the Pacific Coast and into the Rocky Mountain states. Before the 1940s, house finches did not occur naturally in the eastern United States. Pet dealers in New York, however, illegally transported some house finches from southern California for sale as cage birds and abruptly released them just prior to raids by the authorities; the descendants of these birds have now successfully colonized most of the eastern coastal states.

We were able to detect only a minor seasonal difference in the thermogenic capacity of house finches subjected to −94°. Birds captured in Boulder, Colorado, during the coldest winter on record tolerated below −76° for an average of ninety-eight minutes, whereas birds captured in summer averaged only nine minutes. These results are interesting because of both the low endurance capacities of house finches, particularly in winter, and the lack of a dramatic seasonal increase in their thermogenic capacity, compared with the goldfinch findings. Other important differences between house finches and goldfinches emerged when body masses and constituents were analyzed. House finches exhibit no seasonal fluctuation in either triglyceride content, which remains constant at about one gram, or body mass. Finally, in winter, house finches do not reduce their reliance on blood glucose during exposure to cold.

These findings indicate that house finches lack the characteristics that we believe contribute importantly to the abilities of goldfinches to stay warm in cold climates. How, then, do house finches survive cold winters? Perhaps the large thermogenic capacity in goldfinches represents an ability for prolonged heat production that they exploit fully only under exceptionally severe weather conditions; the lower thermogenic capacity of house finches may signify a smaller margin of safety and may result in substantial mortality during prolonged, severe winter storms. The success and persistence of house finches in the northeastern United States, however, suggests that alternative methods are employed for coping with cold winters. House finches, more than goldfinches, appear to rely on filling their crops with seeds just prior to retiring to their roosts for the night. Perhaps other behavioral and physiological adaptations will be identified. The survival of house finches in cold climates may be enhanced, for instance, by their association with humans, in terms of their use of buildings and houses as nocturnal roosts and their dependence on seeds from feeders.

Cold winters provide substantial challenges to small birds, and our research indicates that at least some of the birds respond in ways that make them physiologically and biochemically distinct from their summer counterparts. Further research will undoubtedly uncover additional physiological and behavioral patterns that foster the survival of birds and other organisms in stressful environments. Study of the flight muscles of birds, with their specialization for high oxidative metabolism, can be particularly helpful in understanding the factors that limit the abilities of all animals, including humans, to sustain high rates of metabolism for long periods of time.□

House finches, unlike goldfinches, do not show a marked increase in ability to produce heat in the winter. For them, survival in cold climates may depend partly on seeds from bird feeders.

Laura Riley

A Bear in Its Lair

Although its den provides little protection from the elements of a Minnesota winter, a black bear has a 99 percent chance of seeing spring

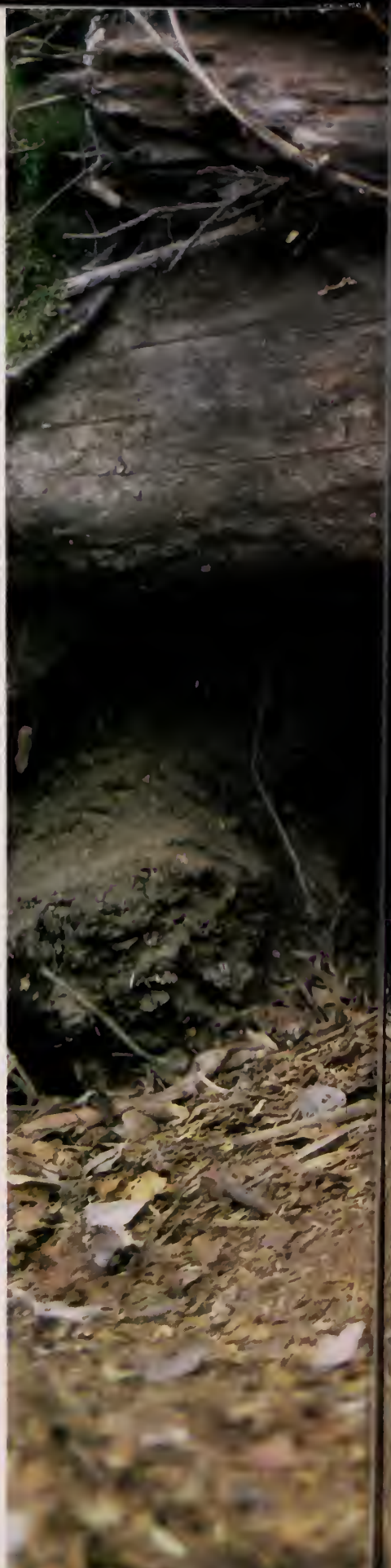
by Lynn Rogers

Winter is the season of highest mortality for most northern mammals. But not for black bears, which are masters of winter survival. Their winter death rate of less than one percent is their lowest of the year.

Once considered not true hibernators because of their high body temperatures in winter, black bears are now known to be highly efficient hibernators. They sleep for months without eating, drinking, urinating, or defecating. Hibernators with lower body temperatures, such as chipmunks, woodchucks, and ground squirrels, cannot do this. These other mammals must awaken every few days, raise their temperatures to over 94°F, move around in their burrows, and urinate. Some of them must also eat and defecate during arousals. Black bears, however, develop far more insulative pelts and have lower surface-to-mass ratios than the smaller hibernators. As a result, the bears' body heat is lost very slowly, enabling them to cut their metabolic rate in half and still make it through winter, maintaining temperatures above 88°—within 12 degrees of their normal summer temperature. This, in turn, means that a black bear can react to danger faster than most other hibernators whose body temperatures may be less than 40°. New knowledge of hibernation processes has led biologists to redefine mammalian hibernation as simply a specialized, seasonal reduction of metabolism concurrent with the environmental pressures of food unavailability and low environmental temperatures.

In northeastern Minnesota, where I have studied black bear behavior and ecology since 1969, bears commonly go for seven months without eating—from mid-September until mid-April. To do that and remain in good condition requires changes in physiology, and some of these changes create conditions in bears that would cause problems in people. How bears remain healthy in winter, and how their adaptations may be used to improve human medicine, have recently become subjects of study at some of the leading medical research centers in the country. For example, bears that are living off their fat have cholesterol levels more than twice as high as their summer levels and more than twice as high as the cholesterol levels of most humans. Yet bears have no known problem with hardening of the arteries or with the formation of cholesterol gallstones. Medical studies have shown that bears in winter produce a bile juice, ursodeoxycholic acid, that may help them to avoid problems with gallstones. When given to people, this acid dissolves gallstones, eliminating the need for surgery. Black bears also greatly reduce their kidney function in winter. They do not urinate for months but still do not poison their bodies with waste products such as urea. The urea is somehow broken down and the nitrogen from it is reused to build protein. This ability to build protein while fasting allows the bears to maintain their muscle and organ tissue throughout the winter. They only use up fat. Evidence is accumulating that the physiological changes that occur in hibernating black bears are controlled by hormonelike substances. These substances also produce hibernationlike effects when injected into other species—both other hibernators and nonhibernators, suggesting possible uses in human medicine.

Hibernation for the black bear, as for other mammals, is primarily a mechanism to conserve energy through seasons of no food or water. The process, however, does not work every year. If there is insufficient food in summer, bears lose weight and starve, much as we would. In northeastern Minnesota, summer is practically the only season with enough of the right foods for bears to gain weight. In other seasons, the right foods are either lacking or so scarce that



Lynn Rogers



bears lose weight. Grass, which bears eat in great quantities in the spring, is not easily digestible. Black bears in my study area begin to fatten up for winter in June, with the ripening of carbohydrate-rich berries. The bears' weight gains in summer depend mainly on the availability of good crops of blueberries, cherries, wild sarsaparilla berries, and hazelnuts. When these and other digestible foods disappear in September, energy conservation becomes the rule until the following May or June.

One exception to this rule concerns bears that are miles outside their usual home ranges when food becomes scarce in the fall. They have to expend considerable energy returning home for winter. A 450-pound, eleven-year-old male that was 119 miles from home on October 15 made the trip back in nine nights, going straight to a den. A second way in which black bears expend, rather than conserve, energy in the fall is by preparing a different den each year. Why they do this—often with the den of the previous year still intact—is anybody's guess. In one case, a fifteen-year-old pregnant female with access to two rock caves she had used in previous winters chose in-



Lynn Rogers

stead to build a nest above ground. (In February of the same winter this female and her newborn cubs became the first radio-monitored black bear family to be killed by wolves.)

For their dens, the black bears I observed generally chose burrows, caves, rock crevices, hollow trees, or excavated depressions under fallen trees or brush piles. A few bears simply built nests on the surface of the ground. Hollow trees were uncommon, but seemed to be preferred for dens because they probably provided the best insulation and protection from hunters and predators. Entrances to underground dens or tree cavities faced in all directions—here the bears had no discernible preferences. The entrances usually were just large enough for the occupant to squeeze through, opening into a chamber that was typically two and a half to five feet wide and two to three feet high. The distance from entrance to bear was usually two to five feet, but in some cases as much as fifteen feet.



Temperatures in the dens depended on snow cover—the bears, with their low metabolisms, did little to warm the space. In winters with several feet of snow, den entrances were often covered and temperatures inside were only slightly warmer than the soil, a few degrees below freezing. In winters with light snow, den entrances remained open and temperatures in the dens were about the same as that of the outside air, frequently 60° below freezing. Open entrances were more common. Those dens acted as windbreaks, but provided little other insulation.

The main insulation for a bear in winter is its fur, which more than doubles in insulative value during the fall. The fur is thickest on the back, neck, and sides and thinnest on the muzzle, legs, and underside. A hibernating bear sleeps in a curled-up position so that its crown is against the den floor and its nose is near its tail. This position minimizes a bear's surface area and reduces heat loss from the thinly furred areas. For extra insulation, bears sleep on a nest of leaves, grass, and other material that they rake into the den. These nests also insulate cubs from the ground.

Females usually give birth to two or three cubs every two years; cubs are born in January, weigh less than a pound, and have practically no hair at first. After giving birth, the female resumes her deep sleep, waking on occasion to tend to the cubs' needs. She licks them to clean them and to stimulate defecation. She eats their feces and moves into position to facilitate nursing. The cubs do not hibernate. They suckle and sleep snuggled warmly against their mother's sparsely furred underside and reach weights of four to eight pounds by the time they leave the den at three months of age.

Ending her hibernation in mid-April, a black bear emerges from her den with two cubs that were born in January. She will suckle the cubs in the vicinity of the den for a few days, then move to snow-free ground.



Jim Brandenburg

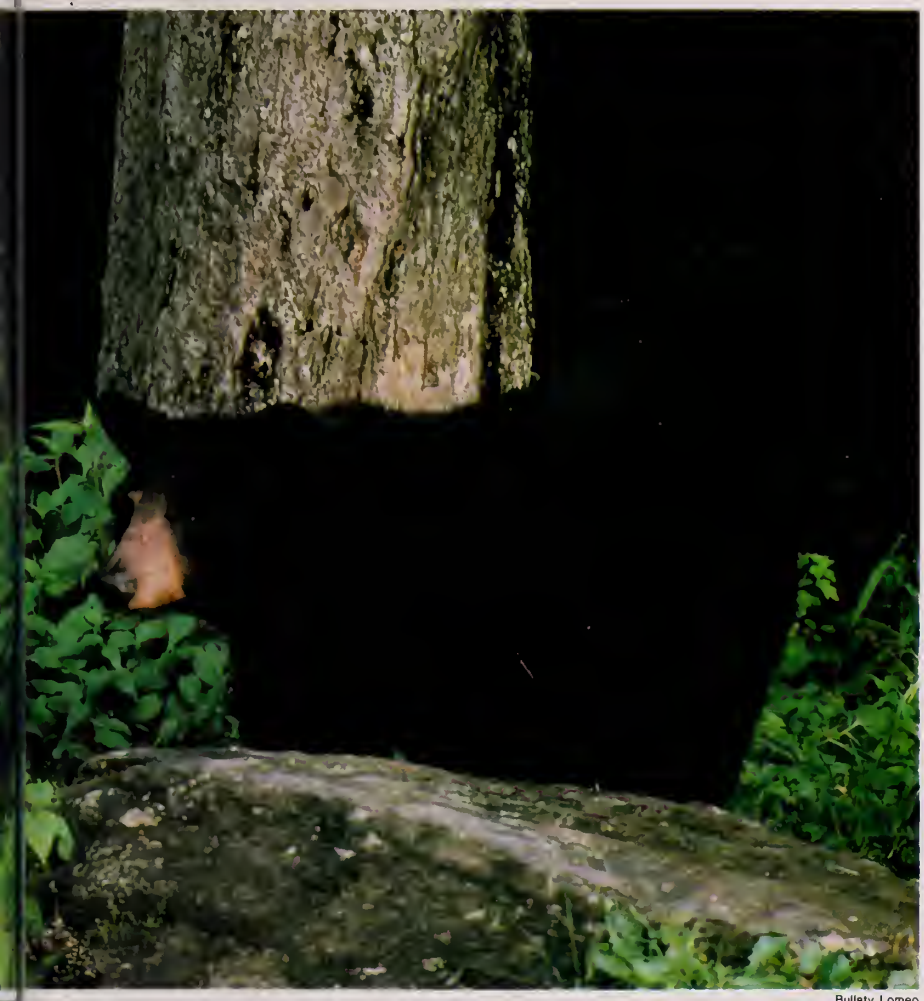


By the time they emerge from their natal dens, black bear cubs weigh from four to eight pounds. As adult females give birth at intervals of two or more years, these cubs, above and right, will remain with their highly protective mothers through the following summer.

The bears under study usually spent considerable time in the fall gathering nest material and arranging it in their dens. Most of them arrived at their den locations well before snow covered the nesting materials, usually in late September or early October. (One arrived on September 2.) After digging a burrow or depression or renovating a rock cave that another bear had used in years past, the bears spent most of their time resting in and around the den or gathering nest material until they entered their dens to stay, usually in late October. Whenever cedar trees were present, bears stripped the fibrous bark from them to use in making nests. The narrow strips of bark, up to several feet long, make a durable bed that does not partially disintegrate and lose insulation value by spring in the way that beds made of finer materials such as leaves, grass, and clubmoss often do. These less sturdy materials were generally the only ones available, however, and so most nests were built with them. A few bears waited until snow covered the ground to start the work of creating a nest, but these were mainly bears that had access to an unusually long-lasting food supply, such as acorns, mountain ash berries, or garbage. They either did not make nests or made them of conifer boughs that they bit from trees.

From September 29 through October 18, 1972, Steve Wilson, Leon Konz, and I worked in shifts around the clock, watching a family of bears settle in for the winter. During the previous week, the animals had completed a burrow under the roots of a fallen pine and with all three cubs (of the previous winter) helping their mother, had begun to rake up bedding from a fifty-foot radius around it. The cubs raked leaves, grass, and forest litter, backing toward the den as they pulled piles of material with their front paws. The five-year-old mother did the same, but in addition, she bit branch tips from willow bushes and pulled up supple Labrador tea plants with her teeth, dropping them on her own piles. She also took charge of arranging all the nest material in the den. The cubs could have done a good job of this, too, as orphaned cubs have demonstrated, but the mother had her own ideas about the nest. Twice she scooped all the material out of the den, sending it flying backward between her hind legs and then putting it back her own way. Except for these vigorous remodeling jobs and instances when the cubs quickly grouped behind their mother after hearing a strange noise, all the actions we saw during this period of den preparation were languid and listless. There was no play. The bears were active only during the day, and during the three weeks of observation the activity decreased from a few hours per day to a few minutes before ceasing altogether.

The activities of these bears followed about the same daily schedule as those of a captive black bear in Alaska whose heart rate Ed Folk of the University of Iowa monitored by telemetry. That bear, too, was active mainly by day as it neared the hibernation period. For most of each day in early fall the bear's heart beat between fifty and ninety times per minute, then for most of each night, while the bear rested, its heart rate slowed to between forty and fifty beats per minute. As fall progressed, the bear began sleeping for more and more of each day. By December, when monitoring ended, its sleeping heart rate had gradually declined to as few as eight beats per minute. This heart rate was as



Bullaty Lomeo

slow or slower than that of most low-temperature hibernators.

Even in hibernation, the captive telemetered bear retained a remnant of its day-active schedule. For a portion of most days, the bear's heart speeded up to more than forty beats per minute, and the animal was wakeful enough to lift its head if the room lights were turned on. Wild bears in northeastern Minnesota also tend to be day active, and most of those I visited in dens were wakeful enough that they lifted their heads and looked at me. Although, in general, they seemed less sensitive to danger than they had been in summer, some were moderately aggressive. A few did not wake up even during several minutes of gentle prodding and jostling, however. In one case, on March 27, 1970, I accidentally fell on a six-year-old female in her den. She didn't wake up for at least eight minutes even though her cub bawled loudly and I began gently prodding her. I wondered if the different receptions I got from the bears reflected differences in their heart rates at the times I happened to visit them. On calm days I could hear the rapid, strong heartbeats of alert bears from the entrances of their dens, but I could not hear the soundly sleeping ones.

On January 8, 1972, I tried to hear the heartbeat of a soundly sleeping five-year-old female by pressing my ear against her chest. I could hear nothing. Either the heart was beating so weakly that I could not hear it or it was beating so slowly I didn't recognize it. After about two minutes, though, I suddenly heard a strong, rapid heartbeat. The bear was waking up. Within a few seconds she lifted her head as I tried to squeeze backward through the den entrance. Outside, I could still hear the heartbeat, which I timed (after checking to make sure it wasn't my own) at approximately 175 beats per minute. This heart rate during arousal is even higher than has been recorded for very active bears.

Research scientists were not the first people to look into a bear den. Indians noted the locations of dens they found in the fall and returned to them in winter to kill the bears for food. They respected bears and had special ceremonies surrounding the killing and eating of them. Members of the Winnebago Bear Clan called the first moon of January the bear moon because it is then that the cubs are born and then that the bears begin to lick their paws. Both observations are accurate. The Indians also believed that mothers washed their newborn cubs with fresh snow. According to a clan saying, snow during the bear moon meant that another cub had been born and that the bears, which had control of the weather, were calling for fresh snow to wash their young. Mothers do lick their newborn cubs, but the use of snow has not been documented in modern times.

Bears commonly lick their paws in late winter and early spring because their calloused foot pads and toe pads flake off during hibernation, and the newly exposed skin is not yet toughened up. Bits of the pads can be found in the feces in spring. Primitive people in northern latitudes around the world believed that bears licked or sucked their paws for sustenance in winter. The Winnebago version of this story is that bears walk on berries all summer, crushing the different kinds into their paws so that in winter they can lick their paws and obtain the essence of the berries.

Another story, which has even been stated as fact in the scientific literature, is that bears eat roughage in the fall to scour the digestive tract and form a plug in the anus. The plug supposedly keeps the bear from eating anything more that fall. Actually, there is an anal plug of feces (along with some bear hairs and bits of nest material), but this forms mainly during, not before, hibernation. Bears continue to make feces during hibernation, even though there is no food intake. Feces are composed not only of indigestible parts of food but also of cells that continually slough off the inside of the digestive tract. By spring, there is quite an accumulation of feces in the colon, and some bears defecate portions of this before emerging. In that case, the feces are deposited in or just outside the entrance to the den, rather than in the nest.

From early fall to late spring most black bears lose between 15 and 30 percent of their body weight. Lactating mothers can lose as much as 40 percent.



Bullaty Lomeo

In northern Minnesota, black bears have from mid-April to mid-September to gain enough weight to carry them through the winter. While hibernating, the bears lose an average of 15 to 30 percent of their body weight; lactating females lose as much as 40 percent.

The mothers that lose the most weight are the ones with the heaviest litters.

Most bears I observed left their dens in mid-April although mothers with undersized cubs sometimes delayed until early May. In years of light snow and early melt, some bears left as early as March 27. In northeastern Minnesota, however, the bears rarely, if ever, came out and wandered around on mild winter days. Somehow the bears were not fooled by springlike conditions before March 27. In one case, during March a fourteen-year-old female had a problem with meltwater running into her den and soaking the nest that she and her two-month-old cubs were sleeping on. She left the den briefly and bit branches off several spruce saplings, bringing them back inside to pile onto the nest and raise the family above water.

For several years Wilson, Konz, and I observed the activities of four family groups day and night as they emerged from their dens in April. They were active only by day, and their activities were much the same in all cases. The mothers began foraging within 150 yards of their dens, leaving their four- to eight-pound cubs in the dens or playing around the entrances. The cubs retreated into the dens at any strange sound, and their mothers returned every ten minutes or less to check on them. The mothers tore apart logs in search of beetles, grubs, and other invertebrates high in protein, climbed aspen trees to eat catkins, ate willow buds and grass, drank meltwater, and in one case consumed a deer carcass we had placed near the den. (Winter-killed carcasses are usually not available to bears in spring because they are cleaned up by wolves, ravens, eagles, and other scavengers before the bears emerge.)

The mothers also spent a lot of time resting in or near their dens. When outside, the cubs were very active, climbing small trees, stumps, or their mothers' backs. Mothers nursed their cubs lying down or sitting up. One mother sometimes sat leaning back against a support, cradling two of her cubs to her chest and licking the tops of their heads as they nursed. After a few days, the mothers moved their families to patches of snow-free ground at the bases of large trees. The ground was still frozen and the surface was wet with meltwater. As all bears do in early spring, the mothers constructed beds to rest on. With trees available for the cubs to escape into, the mothers would leave their cubs for an hour or more.

With all the study of hibernating bears, a basic question remains: How do bears know when to go into or leave their dens? Certainly the bears live by some kind of internal clock, but what sets this clock—day length or some other cue—is unknown. Time of denning and emergence seems to vary to some extent with food supply, weather, and genetics, but how these and other possible factors interrelate is still a puzzle. For the Winnebago Indians the answer was simple: the black bear is a clever and intelligent animal. □



NOW ALL THE BEST BOOKS ABOUT SCIENCE ARE IN ONE PLACE.

ANNOUNCING:
Book-of-the-Month Club
SCIENCE

55 books to choose from on these 4 pages.

BOOKS THAT ANSWER

Q: Are modern computers as smart as any living animal?

A: Today we have machines with the intelligence of the earwig, a tiny insect. This may not seem much, until you realize it took evolution millions of centuries to make the same leap. (See *The Micro Millennium.*)

Q: Can time speed up and slow down?

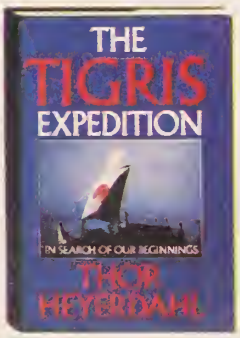
A: Yes, by the theory of relativity. Consider two twins. One leaves Earth in a spaceship, travels close to the speed of light, and returns. Although he's only a few weeks older he's astonished to find that Earth has aged hundreds of years. His twin brother, and everyone he knew, is long since gone. (See *Einstein's Universe.*)

Q: Most important brain functions are represented in both the right and left halves. But which vital function is only found on one side?

A: Speech. There are three speech areas in the brain, but in the vast majority of people they are all on the left side. (See *The Origin of Consciousness in the Breakdown of the Bicameral Mind.*)

Q: Is this the only universe?

A: Reasoning from quantum theory, some scientists now believe there may be other universes in addition to our own—perhaps an infinite number of them! All of the universes, including ours, would be embedded in a mind-boggling entity called "superspace." (See *Other Worlds*)



171 The Tigris Expedition: In Search of Our Beginnings. Thor Heyerdahl. High adventure and danger in an archaeological search for our beginnings.
(Pub price $17.95)



123 Lucy: The Beginnings of Humankind. Donald Johanson and Maitland Edey. (Pub price $16.95)

175 The Soul of a New Machine Tracy Kidder. (Pub price $12.95)

176 The Hite Report on Male Sexuality. Shere Hite (Pub price $19.95)

190 Winning: The Psychology of Competition. Stuart H. Walker (Pub price $11.95)

154 Toward Distant Suns. T. A. Heppenheimer. (Pub price $16.95)



159 The Comet Is Coming! The Feverish Legacy of Mr. Halley. Nigel Calder. (Pub price $12.95)

124 The Origin of Consciousness in the Breakdown of the Bicameral Mind. Julian Jaynes (Pub price $12.95)

149 Science and the Supernatural John Taylor. A distinguished physicist investigates psychic healing, telepathy, psychokinesis and other paranormal phenomena. (Pub price $10.95)

134 Mathematics: The Loss of Certainty. Morris Kline (Pub price $19.95)

185 Green Wisdom. Arthur W. Galston. (Pub price $12.95)



Photograph © 1978
Alfred Gescheidt, Image Bank.

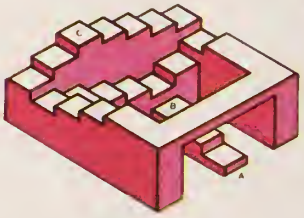
120 The Dancing Wu Li Masters: An Overview of the New Physics. Gary Zukav. The new physics clearly explained, revealing its surprising relationship to Zen.
(Pub price $12.95)

106 Without Me You're Nothing: The Essential Guide to Home Computers. Frank Herbert with Max Barnard. (Pub price $14.95)

110 The Lives of a Cell: Notes of a Biology Watcher. Lewis Thomas (Pub price $8.95)

108 On Human Nature. Edward O. Wilson. How human evolution is interwoven with human behavior. By the author of *Sociobiology.* (Pub price $12.50)

137 Archosauria: A New Look at the Old Dinosaur. John C. McLoughlin. (Pub price $10.95)



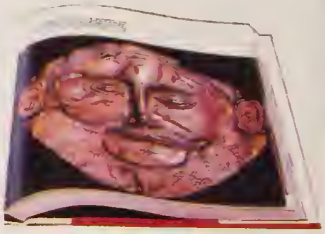
111 Mathematical Circus. Martin Gardner. (Pub price $9.95)

128 The Micro Millennium Christopher Evans. A fascinating analysis of the computer revolution and the dramatic impact it will have on our lives. (Pub price $10.95)

136 The Amateur Archaeologist's Handbook (Third Edition) Maurice Robbins with Mary B. Irving. (Pub price $12.95)

182 Are We Alone? The Possibility of Extraterrestrial Civilizations. Robert T. Rood and James S. Trefil (Pub price $14.95)

113 The Arbor House Treasury of Modern Science Fiction. Compiled by Robert Silverberg and Martin H. Greenberg. (Pub price $19.95)



101 Mysteries of the Past. Text by Lionel Casson, Robert Claiborne, Brian Fagan and Walter Karp Editor: Joseph J. Thorndike, Jr. (Pub price $34.95)

100 Einstein's Universe. Nigel Calder. A fascinating and lucid explanation of the theories that changed man's understanding of time, space and motion.
(Pub price $10)

183 Basin and Range. John McPhee. (Pub price $10.95)

WONDERFUL QUESTIONS.

186 Interferon: The New Hope for Cancer. Michael Edelhart with Dr. Jean Lindenmann, Co-discoverer of Interferon. What it is, how it works, what it may do. (Pub price $11.95)

160 Jane Brody's Nutrition Book: A Lifetime Guide to Good Eating for Better Health and Weight Control. Jane E. Brody. (Pub price $17.95)

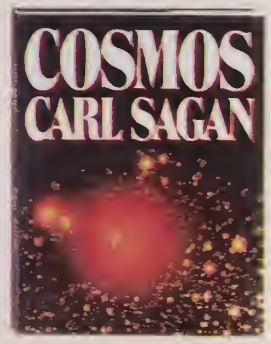
135 From Atoms to Quarks: An Introduction to the Strange World of Particle Physics. James S. Trefil (Pub price $12.95)

167 Other Worlds: A Portrait of Nature in Rebellion; Space, Superspace and the Quantum Universe. Paul Davies (Pub price $11.95)

168 The Self-Sufficient House Frank Coffee. *(Softcover)* (Pub price $9.95)

169 2081: A Hopeful View of the Human Future. Gerard K. O'Neill (Pub price $13.95)

121 The Complete Medical Guide (4th Edition). Benjamin F. Miller, M.D. Revised and updated by Lawrence Galton (Pub price $19.95)



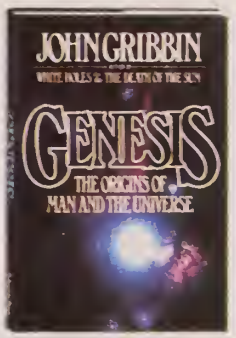
103 Cosmos. Carl Sagan (Pub Price $19.95)

117 Prehistoric Avebury. Aubrey Burl. Striking photographs and a fascinating text explore the mysteries and magic of "the most spectacular prehistoric monument in the British Isles." (Pub price $19.95)

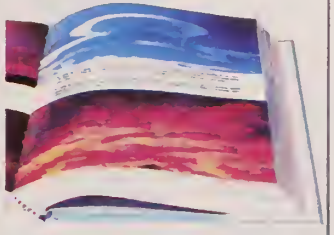
153 Wildlife of the Deserts Frederic H. Wagner (Pub price $18.95)



© Giorgio Gulaco/ Bruce Coleman, Inc.



180 Genesis: The Origins of Man and the Universe. John Gribbin. A time trip from the universe's birth to its probable end, showing mankind's place within it. (Pub price $13.95)



Photographs by Vincent J. Schaefer

161 A Field Guide to the Atmosphere. Vincent J. Schaefer and John A. Day. (Pub price $13.95)

181 An Imagined World: A Story of Scientific Discovery. June Goodfield How the discoveries are really made. "The best book about science since Loren Eiseley's *The Immense Journey*"—Freeman Dyson, author of *Disturbing the Universe*. (Pub price $12.95)

Facts about Membership

You receive the Book-of-the-Month Club/SCIENCE News® 15 times a year (about every 3½ weeks). Each issue reviews a *Main Selection* plus scores of Alternates. If you want the *Main Selection* do nothing. It will be shipped to you automatically. If you want one or more Alternate books—or no book at all—indicate your decision on the reply form always enclosed and return it by the date specified. *Return Privilege:* If the *News* is delayed and you receive the *Main Selection* without having had 10 days to notify us, you may return it for credit at our expense. *Cancellations:* Membership may be discontinued by either you or the Club, at any time after you have purchased 3 additional books.

Black holes twisting space and time like a pretzel—and gobbling down whole planets.

Here on Earth, the stunning adaptability of life: a desert animal that swims through sand the way an eel swims through water. And the ingeniousness of man: a new concept that may generate limitless electricity by duplicating the power of the sun.

And, in each of your cells—a substance called DNA, compressing into an invisibly tiny volume all the information needed to create *you*.

As someone living in an age of unparalleled discovery, you've undoubtedly been curious about things like these.

And you've probably noticed the explosion lately in books about science for people who are not scientists.

But how do you know which are the best?

Let a whole new kind of book club find them for you. Book-of-the-Month Club/SCIENCE.

If you've ever wanted the chance to really explore the wonders of modern science, this is the way. Because now you can be sure you're getting works that are understandable, lively and authoritative.

Book-of-the-Month Club/SCIENCE will lead you to books that indulge your sense of wonder to the fullest, sparkle with discovery, tantalize with new questions.

Books that can change your way of thinking. And the way you and your children live.

We invite you to start by taking any 3 for $1 each.

BOOK-OF-THE-MONTH CLUB

SCIENCE

WHERE THE WONDER IS

CHOOSE ANY 3 BOOKS FOR $1 EACH.

You simply agree to buy 3 books within two years.

Book-of-the-Month Club/SCIENCE
Camp Hill, Pennsylvania 17011

BS113-10X

Please enroll me as a member of Book-of-the-Month Club/SCIENCE and send me the 3 books I've listed below, billing me $3, plus shipping and handling charges, for all 3 books. I agree to buy 3 more books during the next two years. A shipping and handling charge is added to each shipment.

Indicate by number the 3 books you want ☐ ☐ ☐

Mr
Mrs 1-01
Miss
(Please print plainly)

Address Apt

City

State Zip

CHOOSE ANY 3 BOOKS FOR $1 EACH.

You simply agree to buy 3 books within two years.

170 The Mapmakers. John Noble Wilford. (Pub price $20)

184 Cosmic Discovery: The Search, Scope, and Heritage of Astronomy. Martin Harwit. From black holes to infrared galaxies, the unfolding story of today's astronomy and the men who are making the discoveries. (Pub price $25)

187 Extinction: The Causes and Consequences of the Disappearance of Species. Paul and Anne Ehrlich (Pub price $14.95)

174 J. Robert Oppenheimer: Shatterer of Worlds. Peter Goodchild. (Pub price $15)



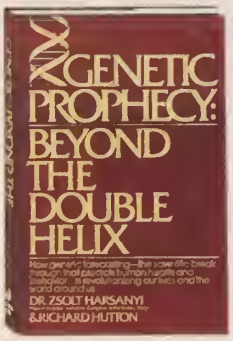
119 Until the Sun Dies. Robert Jastrow. A clear explanation of current scientific thought on the creation of the universe and the origins of life. (Pub price $8.95)



102 A Child Is Born (Revised Edition). Photographs by Lennart Nilsson. Text by Mirjam Furuhjelm, M.D., Axel Ingelman-Sundberg, M.D., and Claes Wirsén, M.D. (Pub price $14.95)

125 Maps of the Mind. Charles Hampden-Turner. A voyage through man's seat of consciousness, illustrated through a series of fascinating diagrams, or "maps." (Pub price $14.95)

105 Gödel, Escher, Bach: An Eternal Golden Braid. Douglas R. Hofstadter. A metaphorical fugue on minds and machines in the spirit of Lewis Carroll. *(Softcover)* (Pub price $9.95)



172 Genetic Prophecy: Beyond the Double Helix. Dr. Zsolt Harsanyi and Richard Hutton (Pub price $13.95)

162 Critical Path
R. Buckminster Fuller
Adjuvant: Kiyoshi Kuromiya
(Pub price $15.95)

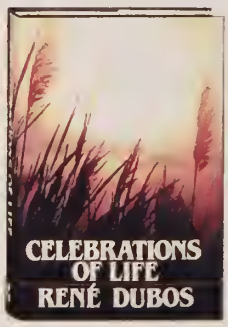
178 Dover Logic Books: *My Best Puzzles in Logic and Reasoning*, Hubert Phillips ("Caliban"); *Recreations in Logic*, D. G. Wells; *Test Your Logic: 50 Puzzles in Deductive Reasoning*, George J. Summers; *Puzzles in Math and Logic: 100 New Recreations*, Aaron J. Friedland. (4 Vols.) *(Softcovers)* (Pub prices total $7.50)

107 The Panda's Thumb: More Reflections in Natural History. Stephen Jay Gould (Pub price $12.95)

130 Sand Rivers
Peter Matthiessen. A visit to Africa's largest and least accessible Wildlife sanctuary with the author of *The Tree Where Man Was Born* Photographs by Hugo Van Lawick. (Pub price $19.95)

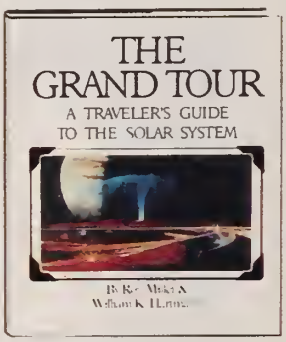
158 Timewarps. John Gribbin. A fascinating discussion of time—its history in human thought, current scientific knowledge and the possibilities of such things as time travel, parallel universes and reincarnation. (Pub price $8.95)

146 Fieldbook of Natural History (Second Edition). E. Laurence Palmer. Revised by H. Seymour Fowler. (Pub price $23.50)



188 Celebrations of Life
René Dubos. A Pulitzer Prize-winning biologist reflects on what makes us human, refuting the notion that we are genetically predetermined. (Pub price $12.95)

179 Drawing on the Right Side of the Brain: A Course in Enhancing Creativity and Artistic Confidence. *(Softcover)*. Betty Edwards (Pub price $8.95)



173 The Grand Tour: A Traveler's Guide to the Solar System. Ron Miller and William K. Hartmann (Pub price $19.95)

BUSINESS REPLY CARD
FIRST CLASS PERMIT NO. 224 CAMP HILL, PA.

POSTAGE WILL BE PAID BY ADDRESSEE

Book-of-the-Month Club
SCIENCE
WHERE THE WONDER IS
A Division of Book-of-the-Month Club, Inc.
Camp Hill, Pennsylvania 17011

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

Book-of-the-Month Club
SCIENCE
WHERE THE WONDER IS

Flowers That Make Heat While the Sun Shines

Some plants that bloom at low temperatures act as solar collectors, hastening the growth of pollen and seeds

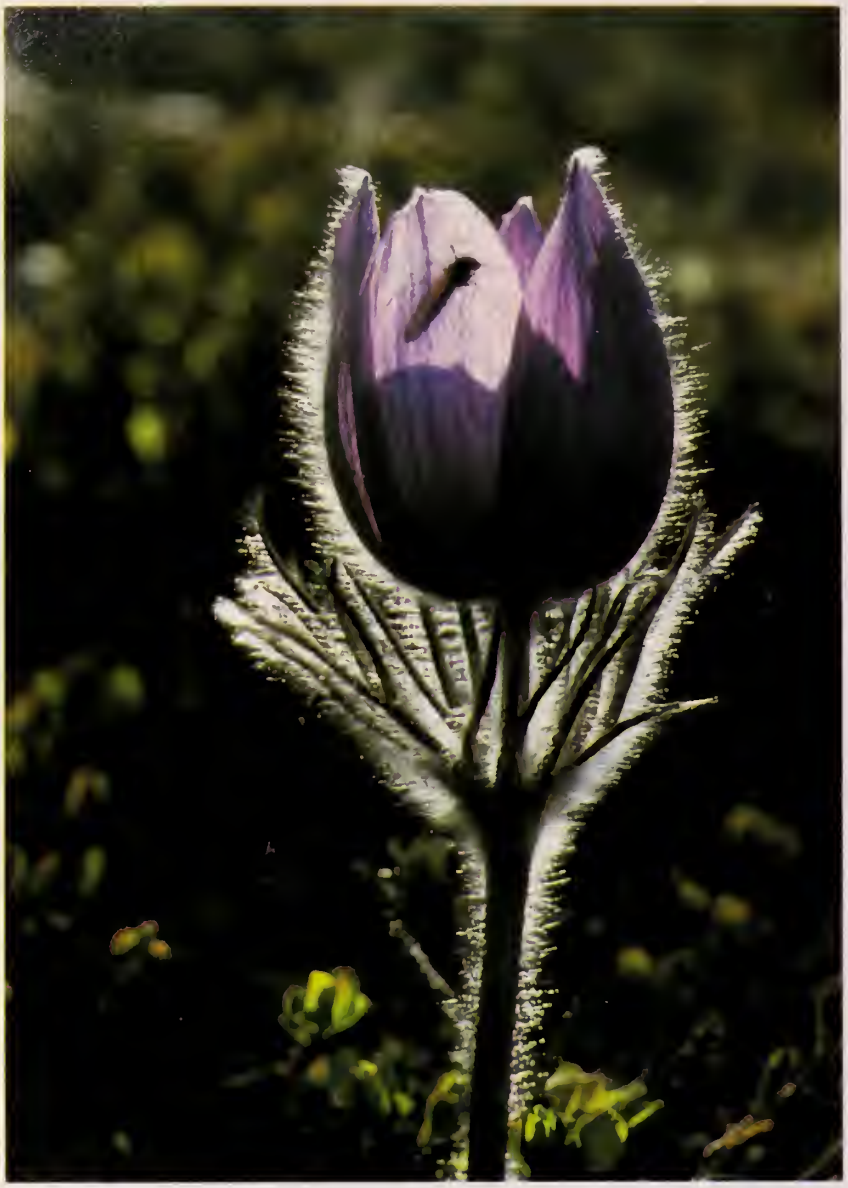
by Roger M. Knutson

My first thought at the sight of a bee, fly, beetle, or mosquito scrambling across a sunlit, early spring bloom is that food needs are being met. Therefore, when one of my students on a botany field trip a number of years ago asked me why so many of the early spring flowers in the forests of northeast Iowa were white, I responded that they were easier for potential pollinators to locate. While that may or may not be true, their brilliance certainly makes it easier for people to see them in the low-angled sun that strikes the forest floor before the trees leaf out. The student's question, however, returned to mind in subsequent springs, and as I thought about it, other generalizations about early spring bloomers suggested themselves. Many of the flowers are bowl or saucer shaped; they are often more or less heliotropic, or sun following; they tend to have reflective petals; and they frequently have centers composed of many fuzzy stamens and carpels. I conjectured that many of these flowers might be accumulating heat by behaving like small dish antennas, focusing reflected light and heat on the flower center where reradiation among the stamens and carpels would effectively retain the heat for a time.

That the green leaves of plants use sunlight for photosynthesis has been known since the late eighteenth century, but how flowers might use solar energy for heating is less well understood, possibly because we cannot see the energy that flowers capture. The red and blue colors visible on the edges of every rainbow are essential to the all-important food-making processes in plants, but beyond the blue and red are colors—wavelengths of electromagnetic radiation—



Pasqueflowers Jim Brandenburg



Left: The cup-shaped blossoms of the pasqueflower collect the warmth of the sun. On a sunny morning in early spring, temperatures inside the flowers can be as much as 18 degrees Fahrenheit warmer than the surrounding air.

Rick Furniss, AlaskaPhoto

Below: Poppies in Alaska follow the sun with their highly reflective petals. The heat stored by the flowers' stamens and carpels may accelerate the development of pollen and seeds.

Nancy Simmerman, AlaskaPhoto



that we can detect only by nonvisual means. Ultraviolet wavelengths are shorter than those of blue light and energetic enough to damage living things exposed to them. Fortunately for life on earth, most of the potentially harmful ultraviolet rays are filtered out by a high-altitude layer of ozone. Bees can see some ultraviolet colors that are invisible to us, and some flowers have ultraviolet patterns that are important in pollination relationships.

At the other edge of the rainbow, red fades into the long infrared (IR) wavelengths, which we do not see but can feel as heat. Almost half of the total solar energy reaching the surface of the earth is in the IR wavelengths. This energy heats all exposed surfaces, evaporating water and warming plants and animals; although abundantly available to plants, it is not used in photosynthesis. The shorter IR wavelengths are the most energy rich and are received primarily from the sun; longer IR wavelengths, associated with radiant heat of lower temperatures, are radiated from all heated surfaces and are absorbed by nearly all surfaces. A room will feel cold to us if we radiate more heat to the walls than we receive from them.

Much of what is understood about the complex energy environment of plants and animals is due to the work of biophysicist David Gates and his colleagues, who have carefully measured and calculated the amounts of energy of all sorts that enter and leave the earth's

environments and the creatures in them. During daylight hours, about one calorie of energy per square centimeter per minute reaches an exposed leaf at the earth's surface, most of it as short-wavelength IR from the sun. That amount of energy is sufficient to heat objects to a high temperature in a short time. If you have ever touched a piece of metal that has been in the sun or sat down on a car seat that has been illuminated for a while, you are aware of just how much heat can be accumulated.

Leaves and petals are not cooked on the stem because of surface and anatomical properties developed long ago by the earliest land plants. Ninety percent or more of the short-wavelength IR striking the surfaces of leaves and petals is reflected, and if water is available and the microscopic stomatal pores of the leaf are open, nearly all the heat a leaf does absorb is carried away by evaporation, much as a sweating body is cooled by water loss. When evaporation is limited or reduced, a leaf in sunlight can rapidly heat to 18 to 36 degrees Fahrenheit above the air around it. According to Gates, leaves would rapidly heat to fatal temperatures if they did not lose heat by evaporation.

In warm climates or habitats with abundant sunlight the problem faced by land plants was excess heat, but as plants moved into cooler climates, advantages would have accrued to those plants able to warm critical parts with heat-giving IR rays from the sun and to direct this heat to the benefit of reproductive processes. Thinking about my student's question and about Gates's work, I wondered what adaptations for the accumulation of heat might have evolved in arctic, alpine, or cool-season temperate plants.

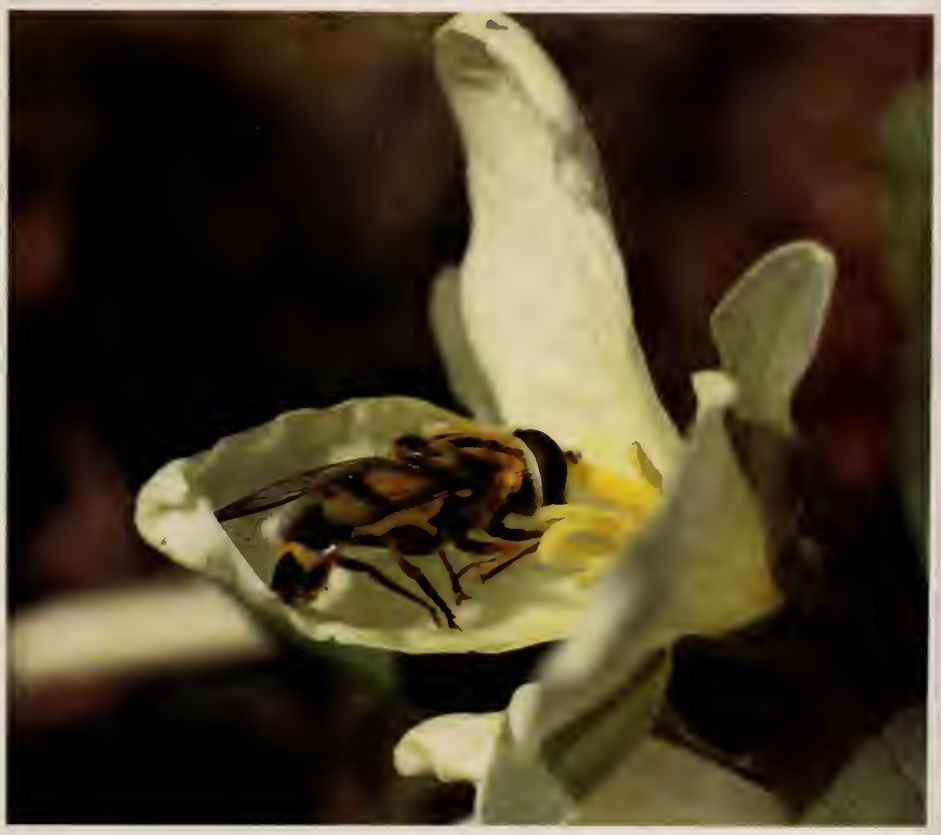
The earliest plants to bloom in northeast Iowa are the snow trilliums (*Trillium nivale*), which follow the sun well enough to make a brilliant display in late afternoon when the viewer's back is to the sun. Although not particularly circular or dish shaped, the snow trillium does have a deep center and three spreading, bright white petals pointed







Rich Tardiff, amwest



Larry Stone

Above: Snow trillium's bright white petals may make it more visible to pollinators. Some insects seem content to bask in warm flowers without feeding. Left: This marsh marigold is truly an early bloomer. Once the flower is free of the ice, its petals, shaped like a shallow bowl, may help accumulate heat from the low spring sun.

directly at the sun. Using small thermistors, I attempted to measure temperature differences between centers of the trillium flowers and the surrounding air. When the sun was out, the temperature in the flower centers was consistently 4 to 5 degrees warmer than the air; the difference gradually disappeared when the flowers were shaded or when a cloud passed over the sun. Several other early bloomers, such as the hepaticas (*Hepatica* spp.) and the anemones (*Anemone* spp.) are less accurate sun followers, but they have a shallow-dish shape, as well as the extremely shiny upper petal surfaces characteristic of the buttercup family. Unfortunately, the anemones and hepaticas were too small for me to take their temperatures accurately with the equipment I had.

The largest early-blooming flower I was able to examine was, not a forest plant, but the prairie pasqueflower (*Anemone patens*). Its flowers, which have a deep-dish shape, are as much as 1.5 to 2 inches across, follow the sun closely, and contain almost innumerable fuzzy stamens and carpels in their centers. The temperature of the first flower center I examined was an exciting 18 degrees above the near-freezing air of an April morning. When the air was still and the sun constant, most of the pasqueflower blooms I measured were from 14 to 18 degrees warmer than their surroundings, and like the trilliums, these flowers returned to near-ambient temperatures when shaded for a time. Small bees, beetles, or other flying insects were always present in the pasqueflowers. Insects frequently spent the night in the blossoms, which closed with darkness, and even when skies were overcast, many remained completely stationary in the flowers for long periods of time. Very little nectar is present in pasqueflower blooms, and while pollen is abundant, few insects were observed feeding on it or carrying it away with

them. Most of the insects seemed content to bask in the warmth of the sun as magnified by the collection plates of the petals and temporarily stored in the fuzzy center structures. If you are small enough, I thought, Palm Beach is as close as your nearest pasqueflower.

These observations were sufficient stimulus to push me into searching out the published research on flower temperatures, which while most interesting, was very limited. In 1965, Brian Hocking and C.D. Sharplin of the University of Alberta, Canada, had reported on the basking behavior of insects in dryas (*Dryas integrifolia*) and arctic poppy (*Papaver radicatum*) flowers on Ellesmere Island in the Arctic Archipelago. They had measured temperatures of 18 degrees or more above air temperature in the centers of the poppies and suggested that both insect and plant germ-cell development would be accelerated by this solar energy bonus in a climate where small energy advantages might be critical for survival. Following up on Hocking and Sharplin's observations ten years later, Peter Kevan, now of the University of Colorado at Colorado Springs, carefully quantified aspects of flower shape and energy accumulation. He found that both spherical and parabolic shapes would focus heat and light directly on the reproductive parts of the flower. Arctic poppies, Kevan calculated, increase the degree-days available for growth by as much as 25 percent because of their passive solar heating. This means that during the six-week-long growing season in the High Arctic, poppies accumulate the equivalent of seven and a half weeks of heat. To test the hypothesis that insects that stayed in those flowers longer than strictly necessary for feeding would reap similar benefits, he measured the heat that insects accumulated by inserting tiny thermocouples in their thorax. On dryas flowers, insects developed temperatures as much as 32 degrees in excess of air temperature.

If insects can accumulate energy from the heat available in flowers, they may seek out the warm flowers during colder periods. The plants could thus conserve energy by accomplishing pollination while providing less food. Moreover, in cold climates, where heat is more abundant near the ground owing to reradiation of solar input and where selection favors small, low-blooming plants, the evolution of efficient parabolic or spherical solar collectors may make the flowers easier for flying, heat-sensitive insects to locate.

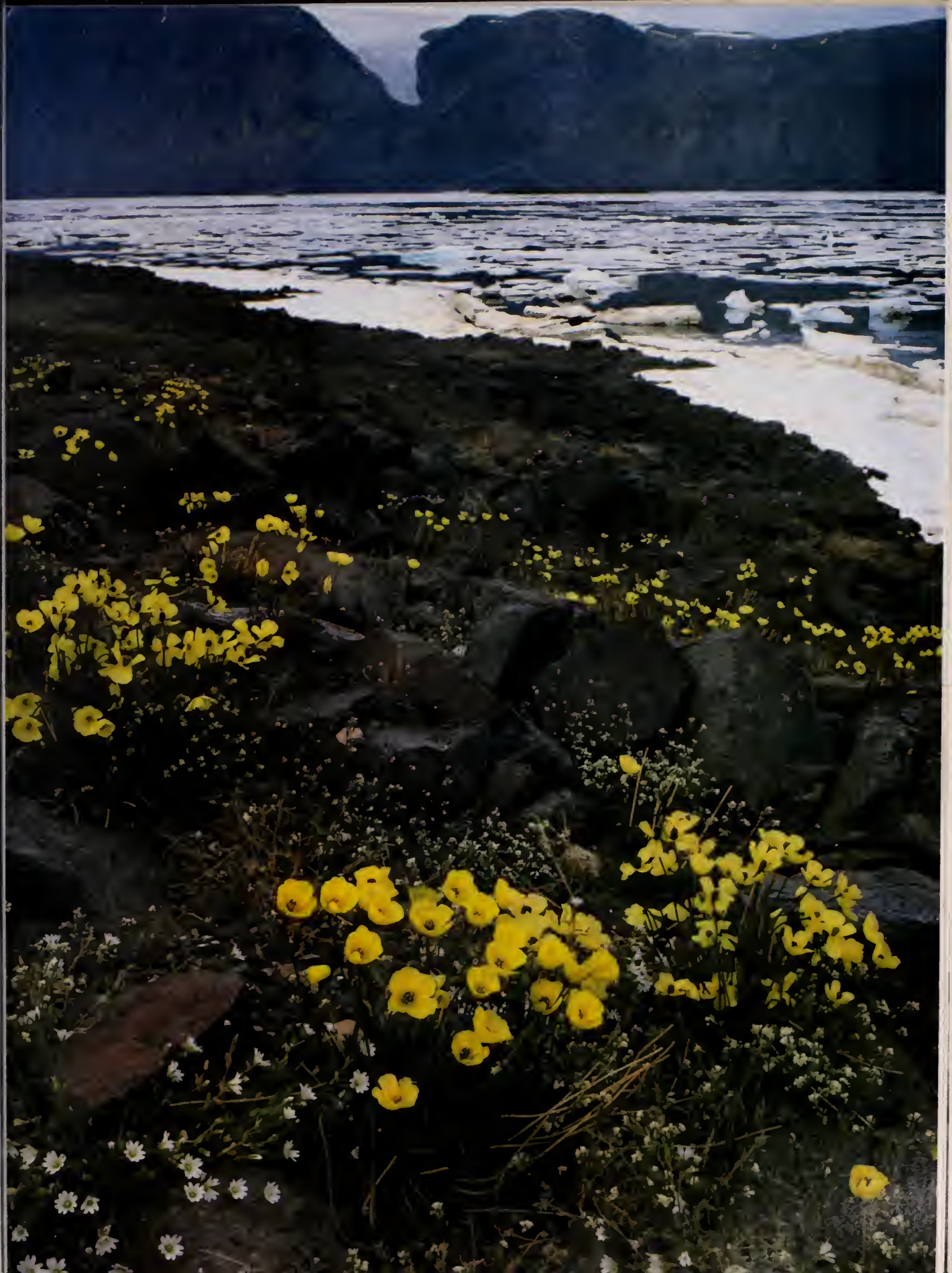
Whether selection in arctic and other cool-to-cold climates has produced collectors or whether those plants already bearing suitable flowers have been more successful in such climates is difficult to determine. The heating of flower centers by radiant energy from the sun may merely be an incidental property of flowers that are bowl shaped for other reasons. If the heating is as important as Kevan suggests, however, then we might expect that selection would operate to produce flowers with deep centers and large, highly reflective petals that are retained for a long time. Petals often have unusual epidermal cells and cutin layers, but whether the reflectivity of arctic or alpine flowers is a result of these characteristics remains to be examined. Meanwhile, as scientists study this little-understood aspect of floral evolution, many flowers of arctic, alpine, and early-spring environments will continue to provide warming ovens that accelerate the development of pollen and seeds and probably also aid the survival and speed the reproduction of visiting insects. □



James N. Skeen

Left: Like many plants that flower in the early spring, these rue anemones begin to develop their fruit while temperatures are still cool. Right: On Ellesmere Island in the Arctic Ocean, arctic poppies bloom next to an ice-strewn fiord. Passive solar heating enables these High Arctic blossoms to accumulate the equivalent of seven and a half weeks of heat in a six-week-long growing season.

Martha Cooper





Plants in High Places

From the high equatorial mountains to the arctic tundra, plants must grow rapidly and reproduce in the cold. How do they do it?

by William Dwight Billings

It is mid-July in the Medicine Bow Mountains of Wyoming, but the temperature is well below freezing and the wind-blasted snow rattles on the back of my parka. One doesn't face into that summer blizzard. Underfoot, the moss campion flowers are pink; snow catches in the cushion of small leaves and is then blown over the 11,000-foot ridge, adding to the snowdrift on the lee side.

It is mid-July at Cape Sparbo, Devon Island, in the High Arctic of Canada. The cold northeast wind is blowing a mixture of snow and cold rain off the sea ice of Jones Sound. The low arctic plants catch the wet snow, but the familiar pink flowers of moss campion at my feet are not yet covered.

These two places are 2,500 miles apart, as the arctic tern flies. The alpine, or mountain, location is at latitude 41°21′ north; the arctic one is at sea level at latitude 75°33′ north, only 950 miles from the North Pole. How can the moss campion (*Silene acaulis*, in the pink family) grow and reproduce so well in two places so far apart in latitude and elevation?

The moss campion, which also grows in Lapland, the Alps, and on Mount Washington, is not the only species that shows a widely disjunct distribution between arctic and alpine places. Of the approximately 1,000 species of flowering plants that live and reproduce in the Arctic, more than half also live on high mountain crests to the south. Are such widely separated places alike in their environments? Were their sites easy for certain kinds of plants to get to? Very few of these species, however, reach the high equatorial mountains and fewer still cross the Equator into the colder parts of the Southern Hemisphere. What are the barriers, in space and time, to the migration of plants?

Estimating the amounts of glacial ice and open land available to plants beyond or above timberline is difficult. At times during the last 25,000 years of the Pleistocene Epoch, glacial ice covered as much as 30 percent of the earth's land area, compared with the present 12 percent; there have also been times when glaciers occupied a much smaller area. At present, of the earth's approximately 57 million square miles of land and glacial ice surface above sea level, about 13 million square miles are too cold for the growth of trees. Of these 13 million square miles, approximately 6.8 million are glacial ice: more than 5.3 million are in Antarctica; about 1.1 million are in Greenland and in smaller arctic icecaps; and alpine glaciers outside the Arctic and Antarctica may occupy 400,000 square miles. The total ice-free land between the glaciers and timberline is about 6.2 million square miles: an estimated 2.3 million square miles are in the Arctic; the remainder consists of about 3.8 million square miles of alpine country in the middle latitudes and less than 100,000 square miles in Antarctica.

Only 0.4 percent of the earth's known vascular plant species occur in the cold 3.9 percent of the earth's land surface that is ice-free in the Arctic. Comparisons of the floristic richness (the number of species per unit of land area) in three areas of approximately the same size (about 24,000 square miles) in arctic, temperate, and tropical latitudes reveal a striking arctic-to-tropics gradient. Peary Land, in northern Greenland, has no more than 100 species of vascular plants; West Virginia has 2,126 species; Costa Rica has at least 9,000. Colder climates clearly support far fewer kinds of plants. In addition, arctic plants belong mainly to families that are not common in Costa Rica, whereas except for such wide-ranging families as the grasses, sedges, and composites, the principal plant families of Costa Rica are absent, or almost so, from the Arctic. The ability to grow and reproduce under the stress of low temperatures is critical to survival in arctic and alpine environments, and in spite of the genetic diversity in large families, there seems to be a tendency for low-temperature metabolism to be either present throughout an entire family or almost completely absent.

But apart from the cold, how similar is the environment in the Arctic to that on high mountains? Certain factors, such as cold nights during the growing season, are more influential in alpine areas than in the Arctic. Other factors important in the Arctic are lacking in alpine areas: continuous daylight for weeks or months, for example, and very cold soils due to permafrost. Furthermore, alpine locations in the tropics have less snow, more ultraviolet irradiation, and a longer (year-round) growing season than those of temperate regions. The relative environmental impacts of many such physical factors vary along latitudinal and elevational arctic-alpine gradients. Only one factor does not change much: the daily mean temperature during the growing season. No matter how cold the winter, how deep the snow, or how brilliant the sun, arctic and alpine plants must metabolize, grow, and reproduce at a consistently cold growing-season air temperature.

Ecologists working to decipher how arctic and alpine species evolve tolerances to such extreme environments

A summer thunderstorm forms over alpine tundra in Wyoming's Beartooth Mountains. Half of the alpine plant species that thrive there, watered by such storms and melting snowdrifts, also grow in the Arctic.

William Dwight Billings



Arctic and alpine ecotypes of the same species are often quite distinct. This alpine sorrel in the Wyoming Rockies cannot photosynthesize as fast at low temperatures as a plant of the same species in the Arctic.

William Dwight Billings

have found the concept of the ecotype to be very useful. In 1922, Swedish botanist Göte Turesson found that within widely distributed plant species, certain local populations evolved tolerances to different kinds of environments. When grown together in his garden under uniform conditions, these populations, which he called ecotypes, maintained their distinctive appearance and flowering characteristics. Genetically distinct entities adapted to a given type of environment within the range of a species, ecotypes may be evolutionary dead ends or, by isolation through time, they may become species in their own right.

In the last twenty-five years, studies of the physiological traits of arctic and alpine species and their ecotypes have produced the greatest advances in efforts to understand plant adaptations to cold-summer climates. For more than twenty years, a number of researchers, including H.A. Mooney of Stanford University, M.M. Caldwell of Utah State University, B.F. Chabot of Cornell University, P.G. Godfrey of the University of Massachusetts, and I have been working with alpine sorrel (*Oxyria digyna*), a widely distributed, but not abundant, arctic-alpine species. In ecotypes of this species, photosynthesis and flowering are closely tied to temperature and to intensity and duration of sunlight. The arctic ecotypes are quite distinct from the alpine ecotypes in form and structure (for example, the usually horizontal underground stems called rhizomes are present in all arctic populations and absent from western American alpine populations), but I shall concentrate here on just a few of the physiological adaptations we have found. These principally involve the ways in which certain plant processes are affected by solar radiation and temperature.

Almost all arctic and alpine plants are perennial and take two or more years after seed germination to reach flowering age. *Oxyria* is no exception. After growing very slowly for two or three years, many of these plants produce, at ground level, a bud containing preformed floral initials that overwinter and bloom very soon after the following summer's thaw. In *Oxyria,* the breaking of dormancy in such flower buds depends primarily on two developments: first, the bud temperature must rise above freezing, and second, day length must have reached the maximum number of hours attainable at the latitude at which the population grows. *Oxyria* plants in the Medicine Bow Mountains of Wyoming won't bloom until day length has reached fifteen hours and those in the Olympic Mountains of Washington (latitude 48° north) must have a sixteen-hour day, while alpine sorrel on the North Slope of Alaska (latitude 71° north) or at the same latitude in Lapland requires the continuous daylight of an arctic summer. At arctic latitudes, however, optimum day length comes before thaw and lasts long after it. Hence *Oxyria* plants there wait until July to bloom, even though by that time the sun has been continuously above the horizon for several weeks.

Another way that sunlight particularly affects alpine plants involves ultraviolet B radiation, the shortest wavelengths of solar ultraviolet light that can penetrate the atmosphere and reach the earth's surface. High mountains have less atmosphere above them, so the amount of such ultraviolet radiation reaching alpine plants is more than that reaching the leaves of plants at sea level. Also, stratospheric ozone, which is somewhat of a shield against ultraviolet B radiation, is much thinner and less dense over equatorial regions than over polar regions; thus, high mountains in the tropic and even in the temperate zones receive much more ultraviolet radiation than does the Arctic. Caldwell found that relatively little ultraviolet radiation gets through the leaf epidermis of alpine *Oxyria* and several other species of alpine plants and that a bit more penetrates the leaf epidermis of arctic *Oxyria* plants. He also measured greater epidermal transmission of ultraviolet radiation in green *Oxyria* leaves than in leaves that the pigment anthocyanin had turned purple or red. The anthocyanin acts as a screen against penetration of ultraviolet to the photosynthetic tissues of the leaf. Caldwell discovered experimentally that ultraviolet injury to the leaves of some alpine plants, including *Oxyria*, can be reversed by exposure to certain wavelengths of visible light. The absence of visible ultraviolet damage in nature probably means that under normal alpine conditions such photorepair mechanisms are constantly at work. Early in the season, for example, when ultraviolet irradiance is high and many kinds of plants emerging from melting snow are whitish due to a lack of chlorophyll, young shoots often develop a bright red color as they synthesize anthocyanin from sugars stored in the roots from the previous summer. Some alpine plants, however, produce little or no anthocyanin in the leaves. In such cases, the ultraviolet is usually absorbed by other, colorless compounds and/or is reflected, as Caldwell and his colleagues found in

the silversword plant (*Argyroxiphium sandwicense*) on the volcano Haleakala in Hawaii.

Each growing season, alpine and arctic plants must quickly produce green leaves capable of fast rates of photosynthesis. We have measured, both in the field and under controlled conditions, net photosynthetic rates of *Oxyria* from many arctic and alpine populations across a wide span of temperatures, from near freezing to as high as 113°F. Almost universally, arctic ecotypes had higher rates of photosynthesis than did alpine ecotypes, and rates were highest in plants grown at the lowest temperatures. *Oxyria* plants grown at the highest temperature, on the other hand, could carry on photosynthesis at higher temperatures than plants of the same ecotypes grown at lower temperatures. Alpine ecotypes can acclimate to temperature changes more quickly and precisely than can arctic ecotypes, which indicates that photosynthetic acclimation is under genetic control. In alpine regions, where temperatures near the ground fluctuate rapidly with changes in sunlight and wind, a plant capable of quickly adjusting its photosynthetic system to fit the moment would be at an advantage. Temperatures in the Arctic are more steady and predictable, so an acclimation mechanism would be of less benefit there.

As plants carry on photosynthesis, starch grains accumulate in the chloroplasts. During the night, this starch is converted to sugar, which is moved out of the leaf chloroplasts into the stem and roots. Chabot found that even during the cold nights characteristic of an alpine summer, chloroplasts in *Oxyria* plants from the Sierra Nevada could make this conversion of starch to sugar. In contrast, chloroplasts in leaves of *Encelia virginensis*, a desert shrub species that grows a bit farther down the east slope of the Sierra, could not convert starch to sugar if subjected to these same cold nights. After only a few days and nights, the accumulated starch broke up the *Encelia* chloroplasts, thereby damaging the photosynthetic system.

All arctic and alpine plants are adapted to metabolizing and reproducing at low temperatures. The local vegetational patterns that are particularly characteristic of alpine regions, however, are caused by other aspects of the environment. These factors could be persistent snowdrifts, rock types, nutrients, or water availability. For example, the upper windward side and ridgetop of a slope lose water because strong winds blow their snow into drifts on the lee side. These snowbanks last well into the summer and supply snow meltwater to moist meadows and wet bogs lower down the slope. The local distribution of alpine species is closely related to this type of soil moisture gradient. Some species are present in all parts of the gradient except under snowbanks that melt very late or that melt completely only in unusually warm and dry summers; those places are bare. Most species, however, exist only in certain parts of the moisture gradients: dry ridgetops, moist meadows, or wet bogs. Thus the use of water by these plants or their resistance to drought is as important to their survival as their ability to grow in a cold environment.

When sufficient water is not available to alpine plants, metabolism slows down markedly in some species but not so much in others that are adapted to getting along with less water during dry periods or in drier sites. Steven Oberbauer and I studied water use by plants along an alpine moisture gradient in the Medicine Bow Mountains of Wyoming and found that each species is unique with regard to water intake, retention or loss of water, and tolerance to water loss from leaves. On the dry ridge, shallow-rooted species tend to be conservative in water use; deep-rooted species, such as moss campion and Parry's clover (*Trifolium parryi*), may use and lose more water by obtaining it from deeper in the soil. Wet-meadow plants, in contrast, tend to lose considerable water.

Oxyria differs from most other plants in its water use, having little or no ability to hold water or withstand drought. In the mountains throughout western North America, the species is confined to rocky places below or near snowbanks. *Oxyria* roots must have a good, reliable source of water because its leaves lose water easily, and it will continue to lose water every day until the water source dries up. Not surprisingly, *Oxyria* never becomes established in drought-susceptible places; on the other hand, it is a poor competitor in the densely vegetated wet meadows. This is one reason *Oxyria* is so site-specific, is not abundant, and seldom grows with other plants along the topographic moisture gradient.

Another factor determining local distribution of plant species in alpine and arctic locations is the ability to obtain and utilize certain mineral nutrients in places where such nutrients are in short supply. Nitrogen and phosphorus, for example, tend to be the nutrients least available in cold soils. More is known about the nutrient requirements of plants in arctic tundra, where the cold soils over permafrost are low in nutrients, than in alpine regions. Most of our knowledge in this regard is due to the work of F. Stuart Chapin III, and his colleagues at the University of Alaska, on the availability and absorption of phosphorus by water sedge (*Carex aquatilis*), a widespread arctic-alpine species that occurs from the High Arctic to the southern Rocky Mountains. Chapin has studied the relation of phosphorus to this species along a latitudinal gradient extending from Point Barrow, Alaska, to the high mountains of central Colorado. In each of five locations, he found that water sedge was restricted to colder soils than those occupied by other sedge species. Under standard laboratory conditions, water sedge ecotypes collected from the coldest, most phosphate-deficient soils demonstrated higher phosphate absorption rates than did ecotypes from more favorable sites. This compensation in absorption rates, Chapin concludes, is primarily a response to phosphate availability rather than to soil temperature.

Many of the factors that influence distribution also affect the different methods of reproduction found in cold-climate plants. In general, there is a latitudinal gradient from alpine regions, where reproduction by seeds is the common method, to cold, wet arctic tundras, where only a few species produce seeds regularly and the dominant plants reproduce vegetatively. This appears to be a reflection of the warmer microclimates and drier conditions in the high mountains of the middle latitudes and tropics. The flat, cold tundras of the north are not favorable—in temperature, length of growing season, or nutrients—to the production of seeds. In the Arctic, even those species that do reproduce by seeds take several years longer to reach the seed-producing stage than the same species farther south.

In the wet tundras, most species of grasses and sedges reproduce vegetatively, by rhizomes. Water sedge, for example, and most of the grasses and sedges associated with it in the tundra near Point Barrow produce seeds only rarely. Some sedges and grasses at Bar-

row do reproduce by seeds, but these are usually successional species that invade the drained basins of shallow lakes. Within twenty-five to fifty years, these pioneers are replaced by other grass and sedge species, which produce seeds only occasionally but which, once established, can reproduce by rhizomes to form round clonal colonies. These single-genotype colonies eventually outcompete the pioneers and meet each other head-on.

Water sedge, the ultimate competitor in cold, nutrient-poor tundras, produces seeds so rarely that it enters lake-bottom succession later than the other species, but its slow-growing, long-lived rhizomes and its phosphate-absorbing ability enable it to dominate eventually. The other species are not eliminated; they simply must live with *Carex aquatilis* and share less of the space and nutrients.

Reproduction by stolons (horizontal stems growing above the ground) and bulbils (small bulbs on flower stalks or in leaf axils) is a form of vegetative reproduction in the tundra confined mostly, but not entirely, to small dicotyledonous plants. Two species of saxifrage, nodding saxifrage (*Saxifraga cernua*) and spider saxifrage (*S. flagellaris*), are good examples. While it can produce flowers and seeds, nodding saxifrage reproduces year after year primarily by bulbils in the axils of the leaves. Spider saxifrage can also produce flowers and seeds—but only once. As it flowers and produces new genotypes with its seeds, this species also sends out stolons, just as a strawberry does, with little plantlets on the ends. Since these plantlets on the ends of the stolons are genetically identical to the mother plant, which then dies, the successful genotype is replicated at the same time that sexual reproduction is producing new genotypes and increasing genetic diversity in the population.

The seeds of sexually reproducing arctic and alpine plants may be dispersed by wind, birds, or mammals. Most of the seeds are small. Some have tufts of hairs, others are hairless and shiny, and still others, such as those of *Oxyria*, have small wings. The wind is capable of pushing the seeds over the hard snow for long distances, and migratory birds may carry them even farther. Peter Raven of the Missouri Botanical Garden has suggested that the New Zealand alpine flora evolved, in part, from seeds carried by the stormy westerly winds from the mountains of Australia and even from Patagonia. Long-distance dispersal by birds is very difficult to prove, but there is abundant evidence from the distribution patterns of certain species of birds and plants to suggest that such dispersal is frequent enough to account for some wide distributions, particularly bipolar ones.

In considerations of the dispersal of arctic and alpine plants, the importance of the comings and goings of the great continental ice sheets cannot be overestimated. When the continental glaciers advanced, arctic species moved slowly southward, forming a band of tundra across the northern plains of North America as their seeds were dispersed in front of the ice. Brainerd Mears, Jr., of the University of Wyoming has recently shown excellent geologic evidence that the present grasslands of Wyoming were tundra during full glacial times.

Long mountain systems, such as the North and South American cordillera (consisting principally of the Rocky Mountains and the Andes), provide excellent pathways between the Arctic and the subantarctic region of Patagonia. During the Pleistocene, the continuing growth in elevation of large mountain ranges was crucial to the evolution and spread of cold-climate plants. When mountains reach sufficient height, they offer the challenge of open lands to those upward-migrating species that have enough genetic diversity to establish successful populations above timberline. Once in an alpine situation, a species can adapt by ecotype formation and, with the aid of wind or birds, "island hop" along a mountain chain, jumping from peak to peak. Along the cordillera in the Northern Hemisphere, alpine species moved southward during glacial periods and northward during interglacials.

The genus *Saxifraga* shows an intriguing distribution of arctic and alpine species. More than 300 species exist in the Northern Hemisphere; only one of these, tufted saxifrage (*Saxifraga cespitosa*), extends into the Southern Hemisphere. Juliana Mulroy of Denison University has studied the ecology of plants of the *S. cespitosa* complex from the High Arctic down the cordillera to Tierra del Fuego. The species extends from the Arctic down the Rocky Mountains to San Francisco Peaks, Arizona. Although not common anywhere along this route, *S. cespitosa* can be found here and there on some isolated peaks and ranges. Then, after a 4,000-mile gap



Fred Bruemmer

Tufted saxifrage grows from the High Arctic down the Rockies to Arizona and along the Andes from Ecuador to Cape Horn. Long ago, migrating birds may have dispersed its seeds from Alaska as far south as Argentina.

Your Bank _____ Account Number _____

City & State _____

PAY TO THE ORDER OF Save the Children 19

Sixteen and no/100 $16.00 DOLLARS

(Signature) _____

MEMO: *U.S. Income Tax Deductible Monthly Sponsorship*

(Your Address) _____

City & State _____ Zip _____

Fill out this check (or use your own) and save the children

For only 52¢ a day (just $16 a month) you can befriend a needy child through Save the Children. Your money, combined with that of other sponsors, can breathe new life into an impoverished village…help hardworking people in their fight for dignity…turn despair into hope for a child who has known only disaster. 52¢ may not buy much where you live. But for the poorest of the poor, where the need is so desperate, it can work miracles.

For your first monthly sponsorship contribution, just fill out and sign the check at the top of this page (yes, as long as you indicate your bank name and account number, it is negotiable). Mail the entire page to Save the Children. Of course, you may use your personal check if you prefer.

TELL US HOW YOU WANT TO HELP BY ANSWERING THESE QUESTIONS.

Your name _____ (please print)

Address _____

City _____ State _____ Zip _____

1 What kind of child would you like to help?
☐ Boy ☐ Girl ☐ Either

2 What geographical area are you interested in?
Urgent need exists in all the areas listed below. Select an area, or let us assign a child where the need is greatest.

☐ **Where the need is greatest**
☐ Africa
☐ American Indian
☐ Bangladesh
☐ Chicano (U.S.)
☐ Colombia
☐ Dominican Republic
☐ Honduras
☐ Indonesia
☐ Inner Cities (U.S.)
☐ Israel
☐ Lebanon
☐ Mediterranean
☐ Mexico
☐ Nepal
☐ Southern States (U.S.)
☐ Sri Lanka (Ceylon)

3 Would you like a picture of your sponsored child?
Shortly after we select a child for you, we can send you a photograph and brief personal history, if you desire.
☐ Yes ☐ No

4 Would you like to correspond with the child you sponsor?
If you wish to write to your sponsored child, Save the Children will deliver your letter and make sure you receive a reply, supplying translations if necessary.
☐ Yes ☐ No

5 Would you like information about the child's community?
When you become a sponsor, your funds are used to help children in the most effective way possible—by helping the entire community with projects and services. For health care, education, food production, and nutrition. Several times a year you can receive detailed reports on these community activities which provide permanent improvements to the child's environment. Would you like to receive such information?
☐ Yes ☐ No

6 Do you wish verification of Save the Children credentials?
Save the Children is indeed proud of the handling of its funds. Based on last year's audit, an exceptionally large percentage (83.5%) of each dollar spent was used for program services and direct aid to children and their communities. Due to volunteered labor and materials, your donation provides your sponsored child with benefits worth many times your total gift. Would you like to receive an informative Annual Report (including a summary financial statement)?
☐ Yes ☐ No
(A complete audit statement is available upon request.)

7 Would you rather make a contribution than become a sponsor at this time?
☐ Yes, enclosed is my contribution of $_____.
☐ Check here for general information about our unique programs for aiding impoverished children.

© 1981 SAVE THE CHILDREN FEDERATION, INC.

NH 10/1/1A

Mail to:

Save the Children®
50 Wilton Road, Westport, Connecticut 06880
Attn: David L. Guyer, President

YOUR SPONSORSHIP PAYMENTS AND CONTRIBUTIONS ARE U.S. INCOME TAX DEDUCTIBLE.

Established 1932. The original U.S. child sponsorship agency. Member of American and International Councils of Voluntary Agencies.



Moss campion roots get moisture from deep in the soil. Water availability and a plant's ability to obtain it or get along with less are two of the factors that influence vegetation patterns in alpine and arctic areas.

Martin W Grosnick, AlaskaPhoto

in its distribution—from San Francisco Peaks to the high volcanoes of Ecuador—the species extends southward down the Andes to Cape Horn. Mulroy found that the South American form, which has been called *S. magellanica*, differs little from *S. cespitosa* of the Northern Hemisphere. She suggests that some of the species' extension down the Rocky Mountains could have been the result of island-hopping by birds and that other, shorter movements could have taken place during full glacials. But the long gap from Arizona to the equatorial mountains and the presence of *S. cespitosa* throughout the alpine and subantarctic regions of South America south of the Equator make it almost impossible not to accept one or more events of long-distance dispersal by birds. Mulroy suggests that alpine Peru may have been the site of *S. cespitosa*'s original introduction to South America, but since some of the wading birds near Point Barrow, Alaska, fly to Argentina for the Southern Hemisphere summer, there is also the possibility that *Saxifraga* seeds could have been carried there and that the species has since moved northward along the Andes. Since the Southern Hemisphere *S. cespitosa* plants differ in small ways from those of the Northern Hemisphere, any long-distance dispersal probably occurred some time ago, but there is nothing to prevent such an event from taking place now.

Studies of present-day distributions of various arctic and alpine species have led to a greater understanding of general biogeographical patterns for cold-climate plants. Most of the ancestors of today's alpine plants appear to have been desert and grassland species that migrated and evolved "up-mountain," especially during the Pleistocene, a period of mountain-building. There is a tendency for alpine floras to show much endemism, that is, to be unique to a given mountain range or mountain system. Once a species has adapted to its particular kind of fluctuating cold environment, there seems to be little back-migration down the mountain to the drier or more forested environments. For these cold-adapted, light-requiring, but not drought-resistant species, migrating to other high mountain ranges or the Arctic is easier. Once in the Arctic, becoming circumpolar or almost so is also relatively easy. Under the right climatic and topographic situations, some of these circumpolar species migrate southward again on the mountains of entirely different continents. Lack of fossils always makes it difficult to say where a given widespread species originated; finding out, by experiment, why and how the species maintains itself where it is currently found is much simpler. Nevertheless, my feeling is that *Oxyria* originated in the subalpine regions of the mountains of southwestern China, where its only closely related relative occurs.

Certainly, many other arctic-alpine species originated in the same way, by migrating up the mountain ranges of Eurasia or North America. There are some truly arctic species in unique arctic environments, but determining how most of these species originated is difficult. The Arctic has had many changes in climate, and at times parts of it may have had a forest cover. A good portion of the endemic arctic vascular plant flora may have evolved in place as climates changed and forest cover retreated southward, but at this time, we can only hypothesize. □

With Pride and Pleasure the Musical Heritage Society offers

The Finest Violin Concerto Recording of this Generation For Just $1

The Tchaikovsky Concerto in D Major

Igor Oistrakh, Soloist
David Oistrakh, Conductor
The Moscow Philharmonic Orchestra

The Tchaikovsky Violin Concerto might well be called the Crown Jewel of romanticism. Brilliant, moving, demanding, and richly orchestrated, it remains among the most popular concertos to this day and a worthy representative of romantic musical literature.

This interpretation (record MHS 4049, cassette MHC 6049) raises the level of beauty, emotional intensity, virtuosity, invention and taste of this work to never-before-achieved heights. David Oistrakh, the conductor, himself one of the greatest violinists of the 20th century is in this recording surpassed by his son Igor, who plays under his father's direction.

The orchestra, the conductor, and the soloist combine to produce, a sound, a mood and ensemble balance so exquisite as to defy description. IT MUST BE HEARD and when heard generates a pleasure and excitement, emotional, intellectual, and even physical. Society members say it is among their most cherished recordings.

We offer the Tchaikovsky Concerto as a sample of the truly superb quality of our records and cassettes.

FREE-NO OBLIGATION MEMBERSHIP

Now you can have this record for just $1, or cassette for $2, together with an absolutely free no-obligation-to-buy-anything-ever membership in the Musical Heritage Society.

When the Society receives your request for this trial record or cassette, we will activate a membership account in your name, and, along with your introductory recording, will include "Selections from Our Master Catalog" containing records and cassettes covering every musical period, carefully chosen from our collection of almost 3,000 records and cassettes.

•The first issue of your FREE, one-year MUSICAL HERITAGE REVIEW subscription will be mailed to you. Published every 3 weeks, the Review is authoritative, lively, and will inform and enhance your enjoyment of classical music.

•Outstanding selections will be scheduled for shipment to you in record or cassette format, whichever you prefer (see bottom of coupon) from each issue of the Review--but there is NO OBLIGATION to accept them. A special response form is enclosed with each Review...and you may use it to order or reject any selections simply by mailing it by the date specified. If you want only the scheduled selections, you need do nothing--they will be shipped to you automatically. You'll have at least 10 days in which to make your decision--If you ever have less time than that, just return the special selections at our expense, for full credit.

•You can avail yourself of the opportunity to purchase Musical Heritage Society recordings at your special member price of $4.95 per LP or cassette, plus postage and handling (deluxe-boxed editions and digital recordings are slightly higher).

Peter Ilyitch Tchaikovsky

CONCERTO IN D MAJOR
FOR VIOLIN & ORCHESTRA, OP. 35



Unforgettable Moments of Musical Pleasure Await You--Send for this Record or Cassette and your Free Society Membership Today!

MUSICAL HERITAGE SOCIETY
14 Park Road
Tinton Falls, New Jersey 07724

•0512701

Please send me Tchaikovsky's CONCERTO IN D MAJOR along with my "Selections from Our Master Catalog." You may enter my subscription to the Society's recording program and set up an account in my name. However, it is understood that I may cancel at any time, and there is absolutely no purchase obligation on my part. My payment for this order is enclosed.

SEND "CONCERTO IN D MAJOR" IN THIS TYPE OF RECORDING:
☐ Record #4049, $1.00 ☐ Cassette #6049, $2.00
☑ # 9037 "Selections From Our Master Catalog

NAME _____

ADDRESS _____

CITY STATE ZIP CODE

YOUR SIGNATURE _____

Send my FUTURE Selections in: ☐ Records ☐ Cassettes

Offer open to new members only. All applications are subject to review before membership is granted. Offer valid within the connecting United States only.

Clothing for Cold Climes

Will synthetics duplicate the insulating properties of natural fibers?

by John V. E. Hansen

Considering the many functions we expect it to perform, the design of the body can hardly be faulted. In one area alone—the regulation of temperature—the body provides engineers and physiologists with a unique system for studying a remarkably successful combination of materials and mechanisms that maintains temperature stability within the limits necessary for human survival. This is all the more impressive given the variation in the amount of energy that must be dissipated by the body. A resting human has a metabolic level, or work rate, on the order of 350 BTUs per hour, which must be dissipated to avoid heat buildup. (BTU stands for British thermal unit; one BTU is equal to the amount of heat required to raise the temperature of one pound of water by one degree Fahrenheit.) When an individual walks, the work rate goes up to approximately 900 BTUs per hour, and a very rapid walk up a slight incline would raise the work rate to approximately 1,200. The work rate of an athlete competing in a long race would be in excess of 5,000 BTUs per hour.

Because the body does not dissipate heat in a uniform fashion, it can accommodate a wide range of heat loads. A closer look at the body reveals an ingenious array of flow controls and heat-transfer mechanisms that accommodate this tremendous range in energy dissipation requirements. These mechanisms are worth examining because they hold the clues to the manner in which we can keep ourselves warm. In other words, if we know how the body controls its heat system, we can probably choose clothing materials and designs that will complement these controls and protect the body beyond its own natural limits.

The extremities play a large role in the several mechanisms by which the body dissipates heat. Human limbs and fingers represent an interesting compromise between carrying out necessary mechanical body functions and at the same time presenting a fairly large area through which heat can be released. Heat is removed from the skin surface by means of four processes: evaporation, convection, conduction, and radiation. Of these, evaporation through the pores of the skin plays a major role when there is a large amount of heat to be removed. The normal evaporation of the body's perspiration can be accelerated by replacing moist air near the skin with drier air. The extent of the resultant evaporative cooling is easily demonstrated. A swimmer leaving the water on a day when there is even a faint breeze will quickly feel chilled.

The evaporation effect, of course, works best when the surrounding air is relatively dry and there is a good deal of body moisture to evaporate. The latter occurs when blood flow increases near the surface and the blood vessels in the body's skin expand, permitting the pores to open. The result of this process, called vasodilation, is to present a warm skin area that offers a maximum amount of perspiration. In order to keep the body warm, the process must be reversed, that is vasoconstriction must take place: the blood vessels in the skin and the pores constrict, and evaporation and blood flow are reduced.

A rich blood flow near the surface and the dilation of blood vessels in the skin not only help the evaporation process but also help to carry heat away from the body by convection—a process whereby heat from the warm body is transmitted to colder air moving around the body. Here again, in order to keep the body warm, the process is reversed by reducing the temperature of the skin, which in turn reduces the heat loss by convection.

The body can also lose heat by conduction—a process in which heat is conveyed from a warm object to a *static* colder object. (The major difference between convection and conduction is that convection involves motion whereas conduction involves static elements.) The higher the skin temperature, the greater the rate at which the body's heat will be reduced by conduction through cooler objects in touch with the skin. Conversely, if the skin's temperature is reduced, the rate of heat loss by conduction will also be reduced.

The last process is radiation, or the emission of energy, which is also influenced by skin temperature because transfer by radiation between two objects is dependent on the temperature difference between the objects. When skin temperature is reduced on a cold day, the skin will radiate less heat, and here again, the constriction of blood vessels helps conserve body heat. The amount of blood flowing from the heart to the hands, for example, is not only reduced as the blood flow to the extremities is restricted but the blood is also cooled through the exchange of heat with the blood returning to the heart from the cold extremities. This is something everyone has experienced on a cold day. As the temperature of and the flow of blood to the hand decrease, the skin of the hand becomes colder and the heat loss to the environment is reduced.

This mechanism applies to the feet as well as the hands. The feet constitute approximately 10 percent of the total body surface, but under hot conditions, approximately 13 percent of the body's heat can be lost through the feet. Under cold conditions, when the heat loss might be expected to increase, it may actually be diminished and amount to only 7 percent of the total. Here again, reduced blood flow and reduced blood temperature are the contributing factors. In some cases the temperature of the arterial blood flowing to the hands or feet may be reduced by as much as 15 to 25 degrees before the blood reaches the extremities. The hands and feet may even attain the same temperature as the surrounding environment.

The manner in which the body regulates temperature by controlling its

Copper man (with electric power leads attached to eye sockets) is used to measure the insulating capability of different systems of cold weather clothing.

Photos by U S Army Natick Research and Development Laboratories



evaporative, convective, conductive, and radiative heat losses through skin changes and the circulatory system is internal. But the body's heat loss can also be controlled by changing the amount of body surface area exposed to the environment.

You may not be aware of the way you unconsciously spread your limbs or raise your arms on a hot day in order to cool off. Cats offer excellent examples of this behavior. On a cold day, a cat will curl up not only to minimize its total exposed surface area to the air but also to shield its stomach from the environment. As the temperature rises, the cat will uncurl, stretch out, and in a truly warm environment, may lie on its back or side to deliberately expose its relatively warm stomach area, all in order to cool off. While there are limits to how humans can copy this feline "presented area" approach to keeping warm, it at least reminds us that the various portions of the body differ in their ability to control the body's heat loss. For example, although the blood flow to the extremities can be clearly demonstrated to vary in volume and temperature and thereby to control the body's heat loss, the same is not true of the head. There is no significant automatic control of blood flow in the head. The amount of heat that can be transferred from the head does not change significantly because the blood flow supplied to the brain is fairly rich, relatively constant, and close to the surface. In addition, the skin on the head does not dilate or perspire as much as the skin on the limbs. Finally, the head is relatively free of the subcutaneous fat layer of other portions of the body; hence there is little insulation between blood in the head and the environment.

Although blood flow to the brain is more or less constant, the rate of blood flow as well as the blood pressure can rise in the cold. When this happens, heat is conserved in the head and torso at the expense of the extremities. The cold body has an interesting effect on the bladder. As blood accumulates in the torso, the additional fluid pressure generates the signal to urinate. This is caused by the constriction of blood vessels when the body is cold, although being cold is not usually thought of as the cause of increased excretion of urine.

All of the foregoing suggests that in attempting to protect ourselves from the cold, we might profit from taking a different approach to protecting our limbs and extremities from that used to protect the head. One might be tempted to concentrate on insulating the extremities because they are the areas through which considerable heat loss can occur. If the body's trunk is amply protected, however, heat loss in lightly protected hands and feet may be tolerable. Some individuals feel quite comfortable working with their bare hands even at moderately cold temperatures because they have a greater blood flow to their extremities than other people have. The head, however, is another matter. Even though it represents only about 5 percent of the body area, the head can "dump" from 7 to as much as 50 percent of the body heat, depending on the conditions involved. This strongly suggests that no attempt to protect the body from cold should omit the head. A full head of natural hair is an indisputable asset in a cold environment, but at least for many males, a head covering would seem to be in order. Equally important, the ears represent prime areas through which body heat can escape.

Looking at the clothing we wear to keep warm reveals our limited choices: we can select clothing on the basis of materials or design or some combination of the two. Clothing materials depend on trapped air to provide insulation. The insulation value of trapped air is considerable, since in the absence of turbulence—the replacement of the warmed air by the cooler air—the heat loss is significantly reduced. Clearly, any material that has the capacity to trap air or that can in some other way provide a still-air layer is a candidate for insulation in clothing.

The principle of creating a still-air layer for insulation can be applied to any article of clothing, which seems to suggest that a single insulated garment would be sufficient to maintain the body at a comfortable temperature. Unfortunately, this is not the case. A single garment would not accommodate the tremendous range of human metabolic activity. It might keep the body warm under moderate working conditions but would overheat it during strenuous activity. This problem has led clothing designers to the concept of layered clothing. Individual layers can be opened to permit a greater flow of air between the layers, or the layers can be removed, as needed, to control body temperature.

As people become overheated in a cold environment, they usually begin to open, loosen, or remove their torso clothing while keeping their headgear on. Given the body's ability to remove heat through the head, a more logical heat-regulation mechanism would be to first remove the hat. A multilayered hat system might also provide enhanced control over the body's heat-regulation mechanism in a cold environment.

In attempting to create the best balance between materials and design, we confront the premise that to be useful, clothing materials must be compressible, flexible, and bendable. And they must be able to "breathe" in order to relieve some of the body's moisture. At the knees, elbows, and in the shoulder area, however, the insulation material will be under compression, reducing the volume of trapped air. When the clothing is fully compressed, much of the still air will be forced out and the thermal conductivity of the compressed insulation material will be the factor governing heat loss, along with such radiation as can occur through the material. Body movement is another factor that must be considered in clothing design. The motion of the body and its garments can set up a "pumping" action that introduces some of the ambient air in between the layers of insulation. In many tropical countries, men wear their shirts outside their trouser tops instead of tucked in, as a way of increasing the convective airflow over their torsos by means of the pumping action.

Many new clothing materials that may keep us warmer in the future have emerged in the marketplace. Advances have also been made in the scientific tools to help the engineers, physiologists, and designers working on clothing. Flat-plate calorimeters, which measure the resistance to heat transfer, are available to determine the insulation value of materials both in compressed and uncompressed states. When moisture is added to the plate calorimeter a more realistic simulation of the body is achieved, at least insofar as temperature and moisture are concerned. Researchers, recognizing that the distribution of clothing on the body and the convective currents set up by the body's own heat will influence the heat and moisture absorbed by the clothing, also utilize conductive replicas of the body, usually made of copper. Precise amounts of heat can be sent through these copper bodies, and by measuring the amount of energy required to maintain them at a given tem-

Prime Down—Nature's Finest Insulator!

Pampers you with warmth Keeps fuel costs down







Wrap yourself in the weightless, cozy warmth of soft prime down . . . and turn the thermostat down (as low as 55° F). It's the comfortable way to beat the high cost of energy. And how marvelous that you can treat yourself to the luxury of Mountainside Concepts' prime down coordinated comforters, robes and slippers at prices you can afford!

We're available for toll-free credit card purchases 24 hours a day, 7 days a week **CALL (1) 800-835-2246.** extension 223 In Kansas call **(1) 800-362-2421,** extension 223. For further general information call **201-465-0200.**

PRIME DOWN COMFORTERS . . . plumply filled from corner to corner with soft, fluffy prime down. Luxuriously warm and so light in weight, you'll sleep lots more comfortably without the oppressive weight of layers of blankets. Made to our meticulous tailoring standards—with smooth, tightly woven 100% cotton cambric covers, channel stitched with hidden innerstitching to prevent down leakage and excessive shifting (Sewn-through stitching is never used). They'll stay plump, soft and warm for years of comfortable sleeping. Machine washable, too. Available in 3 sizes and 3 colors: light blue, camel and navy.

Twin Size 66" x 85" **$100.00***
Full/Queen Size 86" x 85" **$150.00***
King Size 98" x 85" **$185.00***

WOMEN'S PRIME DOWN ROBES . . . wrap you in a cloud of soft, cozy warmth. Perfect gift for the gal who likes to snuggle up with a good book on a cold, blustery night! Robes are contour-cut and tailored of down-proof poly/cotton/nylon, generously filled with fluffy prime down. Machine washable. 3 beautiful colors: royal blue, burgundy and chocolate. 3 sizes: Small (8-10), Medium (12-14) and Large (16-18).

All Sizes **$75.00***

WOMEN'S PRIME DOWN SLIPPERS . . . what luxury to slip your feet into the wonderful warmth of cushiony slippers plumply filled with soft prime down. Marvelous to come home to on a cold, snowy night! Fabric is a down-proof blend of poly/cotton/nylon. Machine washable. A perfect complement to our prime down robe . . . in royal blue, burgundy or chocolate. Sizes: Small (5-6½") Medium (7-8½") and Large (9-10½").

All Sizes **$15.00***

***All prices include postage and handling.**

GUARANTEE

We're so sure you'll cherish the prime down products from Mountainside Concepts that we make you this unconditional guarantee: after 30 days, if for any reason you aren't fully satisfied with any of our products, return them for a full refund (including postage). Additionally, we will replace any product we sell if any defects in workmanship or materials appear within five years. We challenge anyone to equal this guarantee

PLEASE NOTE: Mountainside Concepts is a division of MOUNTAINSIDE MARKETING ASSOCIATES INC. Products are made to our demanding standards and are available by mail only.

COMPARE OUR COST SAVING PRICES AND ORDER TODAY

Please send me the following prime down products: (NH)

COMFORTERS	Light Blue	Camel	Navy	Each	Total
Twin . . . . . 66x85"				$100.00	$
Full/Queen . . 86x85"				$150.00	$
King . . . . . 98x85"				$185.00	$
ROBES	**Royal Blue**	**Burgundy**	**Chocolate**	**Each**	
Small 8-10				$75.00	$
Medium 12-14				$75.00	$
Large 16-18				$75.00	$
SLIPPERS	**Royal Blue**	**Burgundy**	**Chocolate**	**Pair**	
Small 5-6				$15.00	$
Medium 7-8				$15.00	$
Large 9-10				$15.00	$
				TOTAL	$

All prices include postage and handling

SEND TO:

Name (print) _____

Address _____

City _____

State _____ Zip _____

Enclosed is my ☐ Check ☐ Money Order (Sorry, no C.O.D.'s)
Please charge my ☐ American Express ☐ Master Charge ☐ Visa

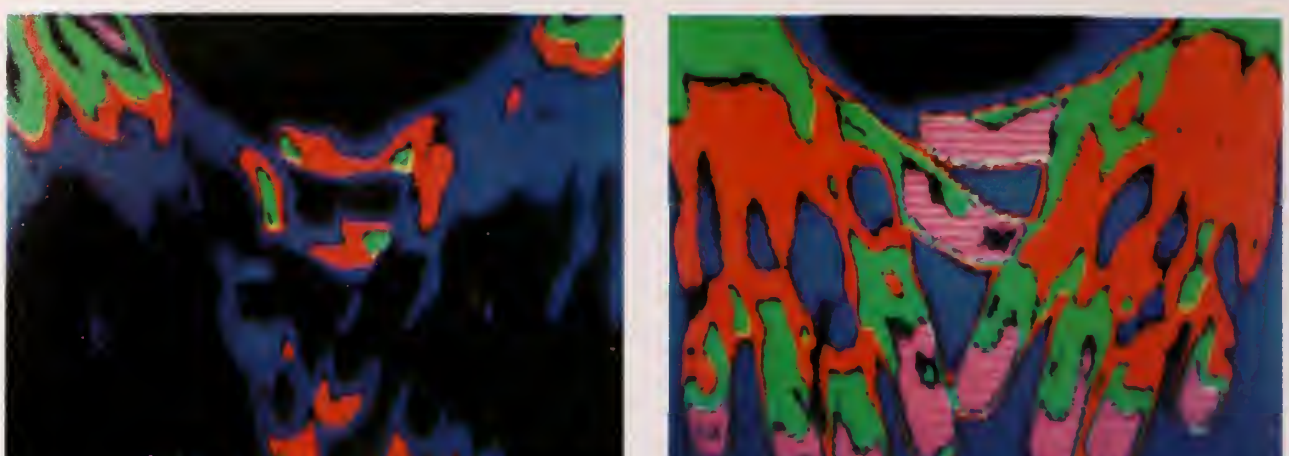
Card No. _____

MC Bank No. _____ Expires _____

Card Member's Signature _____

FILL IN THIS COUPON AND MAIL TO

MOUNTAINSIDE CONCEPTS
60 Oxford Street • Newark, N.J. 07105



Thermographs recorded changes in heat distribution as a pair of chilled human hands, above, regained nearly normal warmth, right. Color changes occurred at intervals of about four degrees Fahrenheit, and darker colors indicate lower temperatures.

perature in a room where the ambient air temperature is also precisely controlled, scientists can measure the insulation capability of the clothing put on the "copper man."

Improvements in infrared scanning cameras also make it possible to take photographs of the "heat leaks" in various items of clothing. These cameras create ten-color images, with each color representing a specific temperature range. Such photographs may reveal significant differences in the protection offered by two seemingly similar items of clothing. With a computer coupled to such a camera, a quantitative assessment can be made of the total heat leak shown in the various areas (at various temperatures) in the photographs.

Yet another tool that is becoming more and more useful in the evaluation of clothing materials is the scanning electron microscope, which examines the textures of fiber surfaces in precise detail. That, in turn, provides clues to the ways in which two apparently similar materials may vary considerably in their ability to trap air and thus in their insulation properties.

Given two insulation materials having fibers with the same surface features, the one with the finer fibers provides more surface area and hence a greater proportion of still air. With two materials of the same fiber diameter, the one possessing small surface discontinuities on the fiber will present the greater surface area and thus a higher proportion of still air.

One way to examine the effect of surface area is to look at some comparative dimensions. Fiber length (or, in the case of feathers, vane length) per gram is the pertinent measure. Synthetic fibers in modern insulation materials may contain as much as a mile of fiber length per gram. By contrast, feathers might yield eight miles of fiber length per gram and high-quality down thirty-two miles per gram.

A comparison of feathers with down demonstrates the insulation limitations imposed by the feather's quill. A quill can represent 25 percent of the feather's total weight and provide very little surface area. In eiderdown, on the other hand, the comparable portion of the structure that contributes little to its insulation is only 8 percent of the total weight. Feathers and down also differ markedly in structure. Feathers are two-dimensional, with vanes emerging on opposite sides of each shaft. Down, on the other hand, is three dimensional. Small wonder, then, that feathers are more apt to pack and compress, while down can be fluffed and tends to remain fluffed up.

Among the natural fibers used in clothing, particularly for warmth, wool offers many desirable characteristics. Fine wools, with a fiber width of 17 microns (about 0.0007 inch), present a large surface area, and wool fibers possess a wavy structure, or crimp, that serves several useful purposes. Crimped fibers interlock more readily, so that they hold together when twisted into yarns. More important, the crimp yields a strong, not easily matted yarn without much twist—just what is needed to produce a porous, low-density structure for insulation.

In designing clothes for warmth, the synthetic-fiber industry cannot be overlooked. Considerable progress has been made in developing materials that begin to duplicate some of the desirable characteristics of natural fibers. Polyester filaments—fibers made of a long-chain synthetic polymer—can be produced with fine diameters, and can also be crimped to provide lofty yarns. Yet another refinement is hollow polyester fibers, which offer significantly greater surface area per unit of length or weight than solid fibers because they are hollow. For example, DuPont's Hollofil (also marketed under the name Hollobond) is an insulation material consisting of hollow polyester fibers that are staple, or short cut (as opposed to the continuous-filament synthetic materials), and have an average length of 2.5 inches and a diameter on the order of 23 microns (about 0.0009 inch). With such short cut fibers, the batting must be quilted to keep the fibers from migrating.

Although quilting has the disadvantage of producing areas of reduced insulation because of compression, it has the advantage of assuring that the fibers will be kept in proper distribution during laundering. Maintaining a uniform distribution of insulation material within a garment is important. Even the best and most expensive insulation materials, such as high-quality down, become relatively useless if they become matted (as

down does, when wet) or if they migrate, leaving areas of reduced insulation. On this score, synthetic fiber insulation materials have a distinct advantage over down in that they take up relatively small amounts of water.

Polarguard, patented by the Celanese Corporation, is another example of a relatively new insulation material. It consists of crimped continuous filaments of polyester, with fiber diameters also on the order of 23 microns. An acrylic resin binder is applied to the surface of the polyester for fiber stabilization and, in conjunction with the crimped fiber form, yields an insulation material that does not easily migrate and shift, thereby eliminating the need for quilting. The fiber crimp also allows the material to simulate the lofty characteristics of such natural materials as wool.

One of the newest insulation materials is the 3M Company's Thinsulate Type C system, which consists of 60 percent polyolefin fibers and 40 percent polyester fibers—two different types of synthetic compounds. While the polyester fibers are on the order of 38 microns (0.0015 inch) in diameter, the polyolefin fibers are of far smaller diameter, with most of them ranging from 1 to 3 microns (0.00004 inch to 0.0001 inch). The term *microfiber* is probably more correct for describing materials of such fine filaments.

The microfibers in Thinsulate C contribute a significantly greater surface area than thicker fibers, thereby trapping more air; as a result, the material has greater insulation value per unit of thickness. On a weight basis, however, both of the previously mentioned all-polyester synthetic materials provide equal insulation per unit weight. (And in terms of weight and thickness, down surpasses all three of the synthetics.) Undoubtedly, future developments in synthetic fibers will yield insulation materials with reduced weight and bulk. The latter is a critical part of the clothing problem because when a person is moving around in cold weather, a small amount of bulk can result in an excessive expenditure of energy.

Much of the work in evaluating synthetic insulation materials under demanding environmental conditions has been done at the U.S. Army's laboratories at Natick, Massachusetts. Unlike the civilian sector of society, which can buy an array of products priced to fit the budgets of a variety of customers, the Army must pay primary attention to



UNSPOILED.

There are few places left on earth that are unspoiled. Sri Lanka is one of them. Once known as Ceylon, Sri Lanka has Asia's best game preserves. 200 species of animals, 425 kinds of birds and hundreds of square miles of leopard, elephant and sambur.

The wild flowers of Sri Lanka include a dazzling display of orchids. And where else could you find 600,000 acres of tea gardens on misty mountains?

There are 75 ways you can tour Sri Lanka. Ranging from 3 to 21 days. Accommodations begin at $5. Deluxe sells for $45. Never has your dollar worked harder. From shopping to sightseeing.

In our ancient cities, you can enjoy frenetic festivals that reflect the unspoiled nature of a culture which dates back 3,000 years.

Whether your visit is pleasure, business or a convention, our unspoiled country will spoil you. Just one hour from India, three hours from Katmandu, Bangkok and Singapore. Write for a color flyer and tour digest that includes special airfare.



sri Lanka
Pearl of the Indian Ocean.

Ceylon Tourist Board/Dept. NH10
609 Fifth Avenue, New York, NY 10017

Name _____

Address _____

City/State/Zip _____

"Physicist's Fire"

with the Texas Fireframe® Grate



"Amazing amount of heat" *BETTER HOMES AND GARDENS*; "Easy to start" *TIME*; "slow-burning" *NEW YORK TIMES*; "No rotation or stirring of the logs" *SCIENTIFIC AMERICAN*; "2.6 × more efficient" *POPULAR SCIENCE*. "Easy to maintain" D. J. Ticko, New Fairfield, CT. "Does a fantastic job" Frank Stanton NYC.

For full scientific description, see L. Cranberg, Am. Jour. Physics, June '81. Reprints on request.

Grate Model S-25: 25" front width, 21" back width, 13" deep. Model KS-25: same, **heavy-duty, gift-boxed**. Model U-25. 25×21×15. Model U-17: 17×14×13. Model U-33: 33×29×15. Copyrighted instructions.

___S-25 @ $44.95 (26#); ___U-25 @ $44.95 (28#)
___U-17 @ $36.95 (20#); ___U-33 @ $56.95 (35#)
___KS-25 @$51.95(31#); ___Reprint (s-a envelope)
Add 10% for shipping in U.S.; Enclose check or Visa, MC # _____ Exp. Date _____

Name _____

Address _____

City _____ State _____ Zip _____

TEXAS FIREFRAME CO.
P.O. Box 3435 Austin, Texas 78764

Marcia Ascher and Robert Ascher

CODE OF THE QUIPU

A Study in Media, Mathematics, and Culture

At the height of their civilization the Incas had no system of writing, but instead used quipus — colored cords, knotted in a special manner — to record and transmit information. Based on a study of quipus found in Inca graves during 19th- and 20th-century excavations, *Code of the Quipu* presents a fascinating anthropological and mathematical study of the problem of interpreting artifacts from a distant culture.

paper **$8.95**

The University of Michigan Press

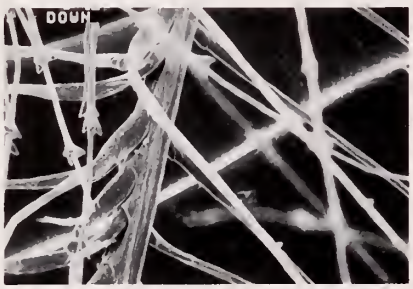
Dept FA P.O. Box 1104
Ann Arbor, MI 48106

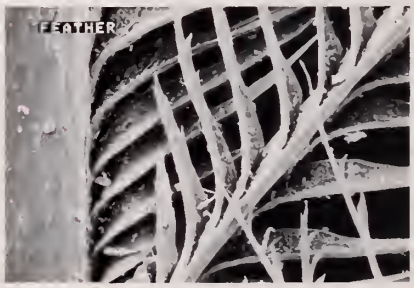
cost. As the price of down has escalated, the newly developed synthetic materials have become of greater interest to the military. The Army also routinely expects to conduct field operations at temperatures of −40°F, and in the evaluation of its extreme cold weather sleeping bag, stringent test requirements were set: the bag would not be considered acceptable unless a soldier could get at least six hours of uninterrupted sleep at −40°. The sleeping bag that passed this test and is now in the Army's inventory contains polyester as well as some strategically placed down. (It should also be noted that synthetic insulation materials are nonallergenic, they do not usually develop any noticeable odors, and they are resistant to attack by microorganisms. These features, along with the materials low moisture pickup, are of considerable importance to the Army.)

For a number of years, efforts have been made to supplement the insulation of clothing by creating a reflecting layer that would reduce the body's heat loss through radiation. Even under ordinary indoor conditions, about 50 percent of the total heat loss through the skin takes place through radiation. Ideally, to keep us warm, our clothing should incorporate a reflective layer that would return to the body some of the heat lost through radiation. This concept has been explored for a number of years but without success. Part of the reason is that the infrared characteristics required in a reflective layer can usually be achieved only by means of a continuous bright metallic surface. If that surface becomes broken or coated with a foreign substance (such as dirt or a body excretion), its reflectance characteristics would be significantly reduced. In addition, for a reflective layer to work, a finite distance must be maintained between the emitting and reflecting surfaces. This would require a spacer material that would keep the two surfaces apart and not allow any significant heat conduction. To date, no such material has been found.

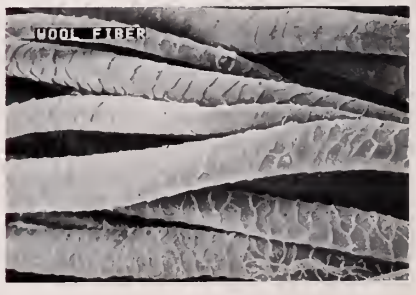
Perhaps the most adventuresome new concept in cold weather clothing derives from recent information concerning polar bears and harp seals. A few years ago, an attempt to photograph these animals from the air to obtain a population count proved difficult because white bears and white harp seals do not show up against white ice. The photographers then experimented with infrared film on the reasonable assumption that creatures containing warm blood might emit radiation in the infrared range that could be recorded on infrared film. To the photographers' surprise, the infrared exposures were equally disappointing and did not differentiate significantly between the harp seals and polar bears and the ice on which they

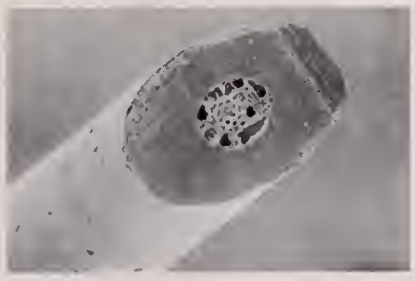
Scanning electron micrographs reveal the structure of natural and synthetic insulation materials. The insulating properties of the materials depend on their ability to trap still air.











The structure of a polar bear hair, magnified hundreds of times in this scanning electron micrograph, may hold the key to new ways of designing protective clothing.

were lying. But when the photographers used ultraviolet film, the results were startlingly successful. The bears and harp seals showed up as black objects on the white ice, indicating that the animals were thoroughly absorbent in the ultraviolet range. This phenomenon was intriguing enough to prompt a study of polar bear skin and hair.

Analysis showed that the tapered bear hair is not really white but is a pigmentless structure with a core of such low density that it is nearly hollow. In simple terms, the polar bear's white appearance is caused in large part by internal reflections in the polar bear hairs. This is analogous to the way in which the whitish appearance associated with ice derives from light reflection off of many internal surfaces. With photographic evidence showing that the polar bear was absorbing energy in the ultraviolet range, there was another question to be answered: Was the low-density core of the bear's hair acting as a "light pipe," permitting the absorbed ultraviolet energy (perhaps now transformed into another form of energy) to be transmitted into the bear's hide through internal reflections? A mathematical model of polar bear hair showed that this was entirely possible. That may mean that in addition to providing useful insulation, polar bear hair may be even more valuable in energy gathering, functioning as a special kind of solar cell. Perhaps tomorrow's cold weather clothing will be made of materials that go far beyond today's "trapped air" insulation techniques and emulate instead the hair of the polar bear. It's something to think about. □

COLD ALL WINTER LONG?

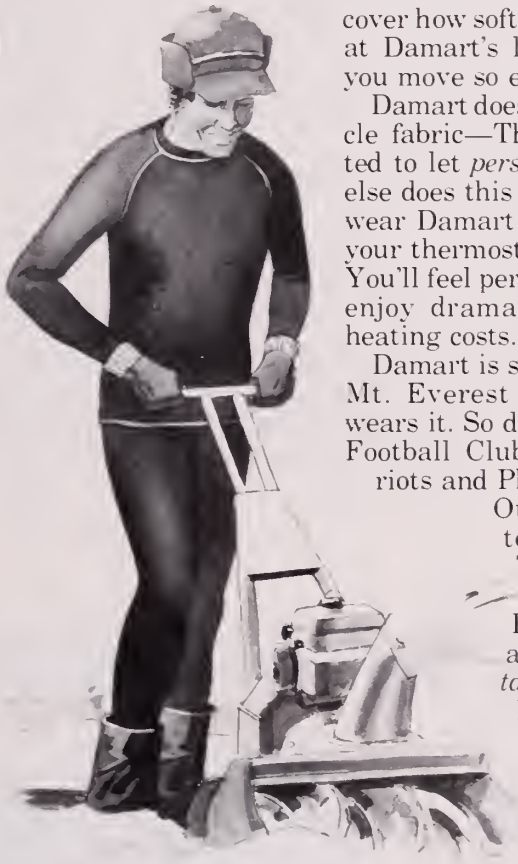
Wherever the winters are cold, with temperatures in the "teens" and "wind-chill factors" even lower, people are talking about Damart Underwear.

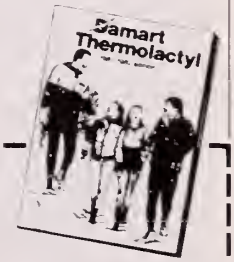
And no wonder! Damart is the unique underwear that keeps you amazingly *warm, dry and comfortable* no matter how cold it gets, no matter how hard the wind blows. No matter how long you stay out! You'll have to run your fingers over Damart Thermolactyl to discover how soft it is! You'll be thrilled at Damart's light weight that lets you move so easily.

Damart does this with a new miracle fabric—Thermolactyl. It's knitted to let *perspiration out!* Nothing else does this like Damart! You can wear Damart indoors too, and turn your thermostat down into the 60's. You'll feel perfectly comfortable and enjoy dramatic savings in home heating costs.

Damart is so comfortable that the Mt. Everest climbing expedition wears it. So does the Chicago Bears Football Club, New England Patriots and Philadelphia Eagles.

Our free color catalog tells the full Damart Thermolactyl story and displays the whole Damart line for men and women, *including tall sizes.* Send for your FREE copy now!





Good Housekeeping

THE PROOF IS IN THE WEARING!

Damart Thermawear

WHEN IN THE BOSTON AREA, VISIT OUR PORTSMOUTH, N.H. STORE (603) 431-4700

THERE IS NO WARMER UNDERWEAR MADE!

Fill out and send to:

DAMART, Dept. 12741
1811 Woodbury Ave.
Portsmouth, N.H. 03805

YES! Rush me your **FREE DAMART** Catalog . . . I want to enjoy the fantastic warmth of Thermolactyl Underwear, a DAMART * exclusive. (I understand there is no obligation.)

PRINT NAME

ADDRESS

CITY STATE ZIP

*®T.M. Damart

Come, Gather Round the Chimney

Staying close to the hearth provided only relative comfort during New England winters

by Jane C. Nylander

In January of 1810, the Reverend William Bentley of Salem, Massachusetts, commented in his diary: "The severest cold I ever knew. . . . Several Old Persons perished within doors. In my own Chamber on Saturday, with a brisk fire, I found the Therm. on the southern side of the Chamber at the greatest distance from the fire at 3 P.M. 16 Far[enheit]. below freezing."

Modern Americans who complain about presidentially mandated daytime temperatures of 68° might learn something about stamina and endurance from a close examination of the life styles of Bentley's early New England contemporaries. Those who have mastered the technology of solar panels or the servicing of an airtight stove, however, can take comfort in the advantages of modern methods of keeping warm that use the same fuels that were available to the good Doctor. These people are involved in an ongoing process of experimentation with improved heating methods and more efficient use of materials that was beginning even in early-nineteenth-century New England.

Coping with winter's chill in the days before there was any kind of central heating required considerable labor and forethought. No one could hope for even a degree of comfort without careful preparation and significant expenditure of money, personal energy, or both. Yet even for those who could afford all the fuel they wanted, it was almost impossible to keep a house warm by relying exclusively on open fireplaces. Anne Jean Lyman wrote of her girlhood home in Milton, Massachusetts:

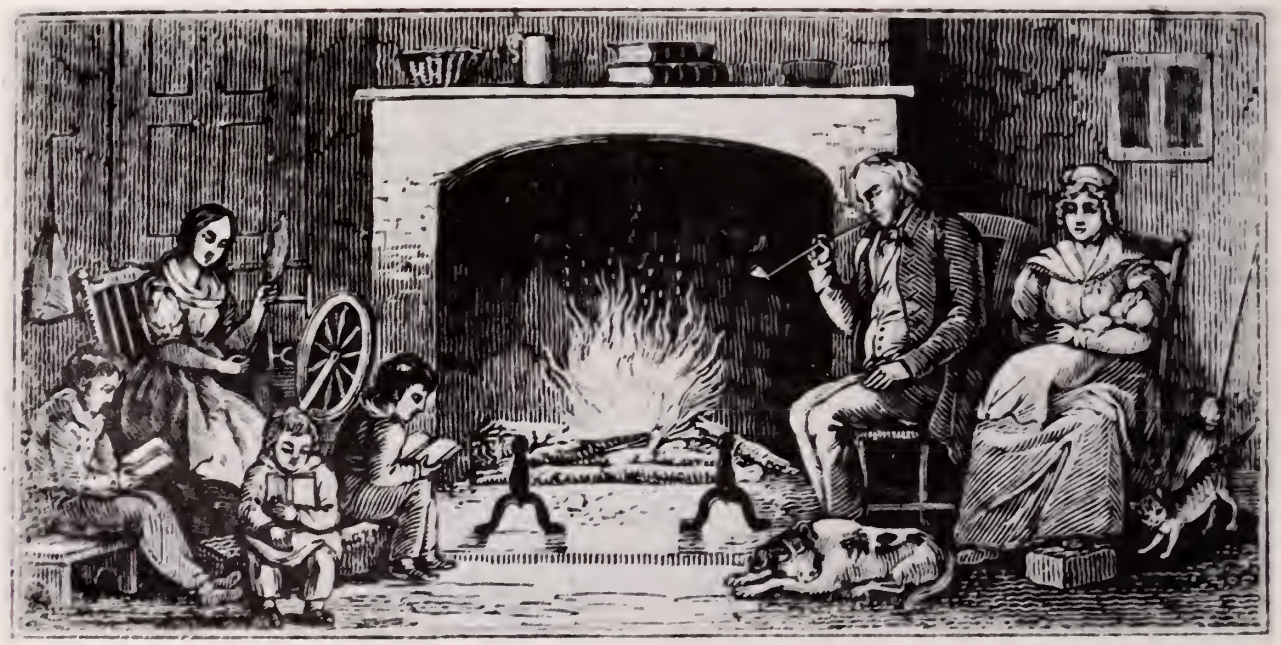
> The winters were long and cold; the appliances for heat not what they are now, the large open chimneys and wood fires being cheerful to the eye, but with their ample draughts not warming to the body. We wore our great coats in the house half the time, Sally and I, and even then could not have been warm without the active employments that kept us constantly busy.

One family recorded "the coldest day we have had" on which the thermometer outside stood at twenty below zero. Upon arising, the family found that the thermometer in the bed chamber stood at three degrees, and with a good fire throughout the morning they were only able to raise it to eight degrees by noon. Apparently, other rooms in the house were somewhat warmer, and some members of the family descended to the parlor to dress beside the fire there. One suspects that the chamber thermometer was not hung near the fireplace, but the actual spot is not recorded.

The winters of New England are often reputed to have once been colder, longer, and snowier than those of modern times. Harriet Beecher Stowe wrote in her novel *Old Town Folks:*

> One of my most vivid childish remembrances is the length of our winters, the depth of our snows, the raging fury of the storms that used to rage over the farmhouse, shrieking and piping round each

N Y Public Library/Coxe-Goldberg Photography



Chairs were pulled as close to the open fire as possible.

angle and corner, and thundering down the chimney in a way that used to threaten to topple all down before it.

In the works of Emerson and Longfellow such storms are depicted in vivid imagery intended to set the scene for an intimate moment forced on people by the power of nature. Despite the dramatic images of depth of snow and intense cold conveyed by poets, novelists, and diarists, careful study of actual winter conditions by historians and meteorologists indicates that these accounts describe extremes. Just as the great eastern blizzard of 1978 will live in the memory of all who experienced it, unusually cold or snowy seasons and severe storms made a vivid impression on people's minds, providing the foundation for these dramatic descriptions.

It is true that there were drifts of snow as high as fourteen feet in late winter of 1717, when Cotton Mather described "as mighty a snow, as perhaps has been known in the memory of man." The year 1816 is frequently referred to as the "year without a summer" for there were frosts every few weeks from May to September. Even Dr. Bentley's January 1810 morning was widely known as "cold Friday"; for generations New Englanders recounted the effects of the spectacular overnight temperature drop of more than fifty degrees and its accompanying severe wind chill. We should remember, though, that diarists and tellers of tales alike have a tendency to record the unusual rather than the commonplace, so it is not surprising that one finds an occasional notation of water in a washbasin or ink in an inkstand freezing in March or October. Such things certainly happened often during the coldest months, but because they were expected at that time of year, they did not provoke comment and were dealt with on a day-to-day basis.

By the end of the eighteenth century, many people realized that large, open fireplaces were not efficient sources of heat. Fireplaces in seventeenth-century New England houses were aptly described as cavernous. We can easily believe the descriptions of people moving a small group of chairs right into one corner of the hearth, since most of the heat of any fire would have gone directly upward through the wide, damperless flues. Even a huge fire built with "a very forest of logs" was not enough to warm much of a room, although some warmth was gained near the fire itself. Eventually, the fireplace would begin to



If you'd like to know some other unusual things about Lynchburg, drop us a line

WHEN GOOD FRIENDS GET TOGETHER in downtown Lynchburg, you'll never see a glass of Jack Daniel's.

The county where we make our whiskey is dry. (It voted that way in 1909.) So when folks have a friendly chat, it's usually over ice cream or soda. Of course, we hope the law isn't as binding in your hometown. And that, at your next friendly get-together, a glass of Jack Daniel's will be somewhere in the picture.



CHARCOAL MELLOWED DROP BY DROP

Tennessee Whiskey • 90 Proof • Distilled and Bottled by Jack Daniel Distillery
Lem Motlow, Prop., Inc., Route 1, Lynchburg (Pop. 361), Tennessee 37352

Placed in the National Register of Historic Places by the United States Government

L.L.Bean®
Outdoor Sporting Specialties



FREE Christmas Catalog

Features Bean favorites for men and women as well as new ideas for practical, functional gifts. Quality apparel and footwear, woodburning products, home furnishings and winter sports equipment. Many items of our own manufacture. All guaranteed 100% satisfactory.

Mail order shopping at Bean's is fast and efficient. Order any time, 24 hours a day, by phone or mail. We ship promptly and pay postage on all orders in the United States and its possessions.

☐ Send Free Christmas Catalog

Name _____
Address _____
City _____
State _____ Zip _____

L. L. Bean, Inc.
761 Casco St., Freeport, ME 04033

BOOK LOVERS LOVE US.
Music lovers too!



We're Publishers Central Bureau and we've been offering savings of up to 83% on bestsellers, publishers remainders, overstocks, and new, complete editions of books, records and cassettes for nearly 50 years. We stock over 20,000 titles covering every subject from Art to Cooking, Fiction to Reference works, Beethoven to Buddy Holly. Many of our titles are unavailable elsewhere and all are unconditionally guaranteed. Send now for our latest catalog without cost or obligation.

Complimentary Catalog Request

Publishers Central Bureau
Dept. EA • One Park Avenue
New York, NY 10016

Please Use Block Letters

Name _____
Address _____ Apt. No. _____
City _____
State _____ Zip _____

radiate heat directly into the room, driving the cold back into the corners. The process juxtaposed radical extremes of heat and cold, a confrontation made vivid by John Greenleaf Whittier in his poem "Snowbound": ". . . the red logs before us beat/The frost-line back with tropic heat."

Masons and housewrights gradually realized that smaller fireplaces would be more efficient. By the early nineteenth century, most New England fireplaces, with the possible exception of those in kitchens, were much smaller and shallower than those that had been built a hundred years earlier. The newly constructed fireplaces had smaller throats and sharply angled sides designed to reduce the amount of heat lost up the chimney and to increase the amount radiated into the room. The published works of Massachusetts natives Benjamin Franklin and Benjamin Thompson, Count Rumford, explained new methods of building fireplaces that were at once more efficient and less smoky. In many of the earliest houses, the smaller fireplaces were built right inside the old ones. Sometimes this process was repeated more than once with an even smaller fireplace being constructed inside the preceding ones in a continuing attempt to increase heating efficiency. Kitchen fireplaces remained larger as long as they were used for cooking because space was needed to accommodate not only a main fire with its large pots and kettles suspended from a crane or a lugpole and trammel (a device for hanging a pothook) but also several small piles of coals and the gridirons, trivets, toasters, and spiders being used to cook over them. A huge roaring fire was not advantageous for cooking since there was no way to control its heat, but maintaining a useful pile of glowing coals for cooking often resulted in a chilly room. Thus Harriet Beecher Stowe could describe how "Aunt Lois, standing with her back so near the blaze as to be uncomfortably warm, yet found her dish-towel freezing in her hand, while she wiped the teacup drawn from the almost boiling water."

To conserve heat provided by a kitchen fire many New Englanders hung blankets from a wooden "blanket crane" or from a series of iron ceiling hooks in front of the fireplace. High-backed wooden settees drawn up to the hearth served the same purpose. By enclosing a small space, it was possible to maintain a more even level of warmth. The daughter of the Knight family of Hancock, New Hampshire, recalled that her mother built a sort of tent near the fireplace on the coldest days, suspending blankets around the children to protect them from the bitter drafts of air that blew in around the windows and through the cracks in the walls of their house.

Many early New England houses were constructed with central chimneys, which even when only one fire was actually lighted always kept some warmth radiating through the building. Against such a chimney, grapes ripened, eggs hatched, motherless infant lambs and calves warmed, and geraniums kept from freezing. In a chimney cupboard, wines and fruitcakes were left to ripen.

Herman Melville saw a purpose to the chimney's warmth in developing "cordials, to a choice mysterious flavor, made so by the constant nurturing of the chimney's gentle heat, distilled through that warm mass of masonry. Better for wines is it than a voyage to the Indies; my chimney itself a tropic." This seems somewhat romanticized when we consider ink bottles frozen on the mantlepiece and washbasins frozen and cracked upon the hearth! But Melville saw the central chimney in his house as a source of family unity, and in "I and My Chimney," he praised the fireplaces that

> all congregate in the middle—in one grand central chimney, upon all four sides of which are hearths—so that when, in the various chambers, my family and guests are warming themselves of a winter's night, just before retiring. Then, though at the time they may not be thinking so, all their faces mutually point to one center; and when they go to sleep in their beds, they all sleep round one warm chimney, like so many Iroquois Indians.

Houses, such as Melville's, with a central chimney, had no hallways. The rooms opened on to one another, depriving the occupants of privacy but encouraging in them a sense of interdependence—a feeling of community that Melville saw as another virtue of central chimneys.

Although most center-chimney houses were built with three or more fireplaces per floor, fires were not kept burning in many rooms at one time, especially when there were rooms that were not occupied. The danger from flying sparks and coals was enormous, and the amount of wood or other fuel required to maintain constant fires was

tremendous. Harriet Beecher Stowe describes a rural house as follows:

> The one great central kitchen fire was the only means of warming known in the house, and duly at nine o'clock every night, that was raked up and all the family took their way to bed chambers that never knew a fire, where the very sheets and blankets seemed so full of stinging cold air that they made one's fingers tingle: and where, after getting into bed there was a prolonged shiver, until one's own internal heat-giving economy had warmed through the whole icy mass. Delicate people had these horrors ameliorated by the means of a brass warming-pan—an article of high respect in those days.

In many homes, heated bricks or stones were used as foot warmers in beds, but the real luxury was a bed warmed by a long-handled metal warming pan filled with hot coals and then rubbed smartly between the cold sheets, thereby imparting a freshly ironed surface to the linen and a bit of temporary warmth to the entire bed. Some staunch New Englanders regarded the use of warming pans as a luxury to be reserved for the sick or the elderly, but for those who yielded, the warmth was real.

Faced with the difficulty and danger of heating a large number of rooms during the coldest months, many people reduced their actual living space within their homes, closing off unneeded rooms and rearranging furnishings. Jonathan Sayward of York, Maine, wrote in his diary of the seasonal ritual of taking down and setting up his high post bed in different chambers. During the extended absence of her husband during one Vermont winter, Mrs. Royall Tyler moved her bed into the north parlor, her two younger children slept in the bed with her, and the older ones slept in a trundle bed in the same room. Anne Lyman wrote to a friend, "Our house is warm enough, that part which we use." Household furnishings of this era were usually light and, with the exception of high post beds, they could be moved fairly easily within a household in order to take advantage of a steady source of heat, adequate light, or a change in circumstances. Arrangements of room furnishings were not maintained for months or years at a time as they are today. Drop-leaf or folding tables, lightweight side chairs, small stands, and sewing tables could easily be assembled—for an activity or a meal—near a window with bright sunlight streaming through it or near a warm fireplace. Upholstered furniture was rare before the end of the eighteenth century, the most common form being side chairs. Comfortable easy chairs were expensive, yet those who could afford them used them functionally, drawn near the fireplace in a bed chamber where their broad wings offered added protection from drafts of cold air.

During this period, spaces within houses were normally defined by their location or function. Historians find references to southeast and northwest parlors or chambers, kitchens and keeping rooms, sitting rooms and dining rooms. There were best rooms and family par-

N.Y. Public Library Coxe-Goldberg Photography



The danger of sparks igniting children's clothing was constant.



Our handy knife-rule fits as neatly in your pocket as it fits your needs.

You've never owned anything like this. Not only is it a stainless steel pocket knife that's just 3" long and 3/16" thick when closed—with two blades of fine Sheffield steel. It's also a 6-inch precision rule engraved by Rabone-Chesterman of England, who are known the world over for precision rules. But, the best part of all? You don't have to go any further than your pocket for it.

Send for the Garrett Wade Knife-Rule and our introductory catalog. It's full of fine woodworking tools.

Garrett Wade Co.,
Dept. 18
161 Ave. of the Americas
New York, N.Y. 10013
Please send me ____ pocket knife-rule(s) @ $2.50 p.p.d plus introductory Garrett Wade Catalog

☐ Check/Money Order enclosed
☐ Visa/Master Charge/American Express

Card No. _____ Expires _____
NAME _____
ADDRESS _____
CITY _____
STATE _____ ZIP _____

ASTRONOMY's Space 1982 Calendar

$6.95

Buy 3 Calendars for $20.85 Get a 4th FREE

postage and handling included



The Sun. The Moon. The Planets.

Beyond the Milky Way to the Nebulae where Stars are born.

14 beautiful images suitable for framing, plus notable dates in astronomy and space science.

ASTRONOMY's Space 82 Calendar. It's a trip through time and space.

Please send me____copies of ASTRONOMY's Calendar. Enclosed is my check for $_____.

Name

Address

City State Zip

Allow 4 to 6 weeks for delivery. Mail to ASTRONOMY Magazine, ORDER DEPT., P.O. Box 92788, Milwaukee, WI 53202 G-1-1



Send $3 for catalogue to Dept. NH-10 Box 31442, San Francisco, CA 94131

Boutiques in San Francisco, Palo Alto & Cupertino, CA

lors, but rooms were not designated by the names or sexes of the occupants. There seems to have been no concept of personally defined space in the twentieth-century sense. Melville's concept of interdependence is reinforced by more than the image of a house without hallways. Sleeping arrangements were apt to be far more informal than they are in our post-Victorian period. Studies of the inventories of early houses show that beds were set up almost anyplace. In the seventeenth century, the best bed, normally occupied by the parents of a family, was usually set up in the hall, a multipurpose room that was at once the most used and the most expensively furnished room in the house. In later times, the best bedroom moved to the second floor although, as we have seen, the bedstead itself might be moved when the coldest months arrived.

Children and servants might sleep in rooms that were furnished with an assortment of tools, storage containers, and miscellaneous objects such as saddles, fishing equipment, or old spinning wheels. They might also find themselves sleeping in spaces that were not even finished rooms: for example, attics, second-floor lean-tos, and the spaces at the top of back staircases. Harriet Beecher Stowe described the experience of two boys sleeping in such a space in winter in her novel *Old Town Folks*. Waking in the morning to find that a lighted candle had been placed on a large chest by an early-rising relative, one confessed that "one of my sinful amusements consisted in lying and admiring the forest of glittering frostwork which had been made by our breath freezing upon the threads of the blanket" in a room where "the snow, drifting through the loosely framed window, often lay in long wreaths on the floor."

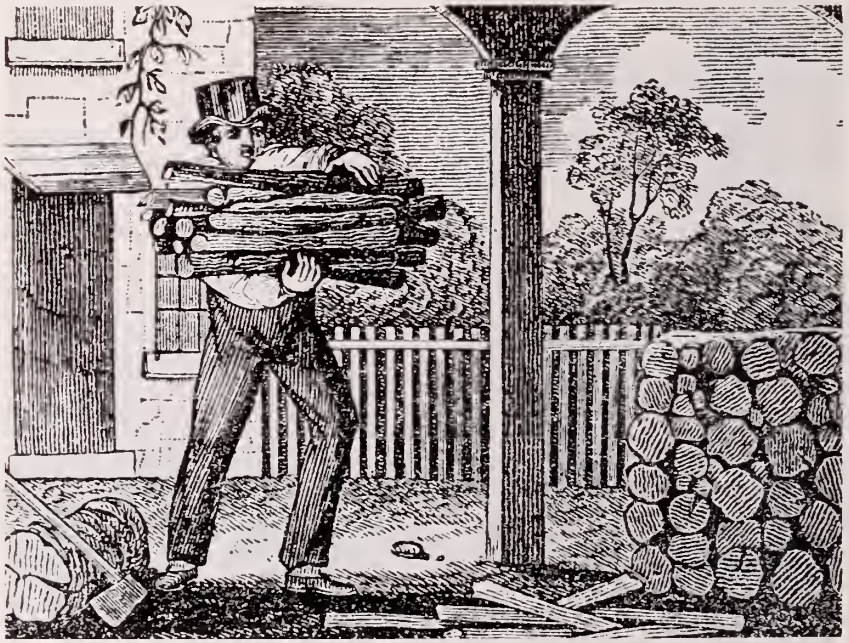
Frugal housewives were not unaware of the advantages to be gained by freezing food in such spaces. Some early cookbooks recommended quantity cooking in the late fall when ingredients were abundant. One suggested that as many as one hundred pies be baked at Thanksgiving time and then stored in blanket chests in cold bedchambers. Mrs. Stowe described

> a great cold northern chamber, where the sun never shone, and where in winter the snow sifted in at the window cracks, and ice and frost reigned in undisputed sway ... fitted up to be the storehouse of ... surplus treasures. There, frozen solid, and thus well preserved in their icy fetters, they formed a great repository for all the winter months, and the pies baked at Thanksgiving often came out fresh and good with the violets of April.

Unless, that is, there was a January thaw!

Despite its advantages in food preservation, extreme cold in kitchens was an inconvenience as well as a source of personal discomfort. In 1793, Anna Palmer described a problem of provid-

Old Sturbridge Village, photo by Henry E. Peach



A good supply of winter firewood required considerable labor.

ing hospitality when a guest arrived late one cold winter evening. "It was very inconvenient," she wrote, "the fire in the kitchen had been out for hours and everything was frozen." She was obliged to start another fire, and to thaw cheese, water, and bread before she was able to serve her guest a simple meal of tea, toast, and cheese. Even daily kitchen chores were rendered difficult by severe cold. One housekeeper noted in her diary, "Hard frost is very inconvenient in one's larder. You cannot lay by a little broth or gravy without its becoming as hard as stone, sometimes breaking the vessel that contains it, and not available on short notice."

The cold drafts of which the early diarists and letter writers complained were difficult to prevent, for cracks opened up in even the most well built houses as wood and putty shrank or glass cracked. In areas of new settlement, houses were quickly constructed of green wood, and it was particularly difficult to keep out drafts during the first few heating seasons. A variety of measures were used to seal up cracks or prevent drafts. Banking the house foundation with leaves, straw, and other vegetative debris appears to have been a common practice in rural areas. Noah Blake of Deerfield, Massachusetts, used cornstalks and pumpkin vines for this purpose in December of 1802; many other New England diarists describe the practice without specifying the material used.

By the 1830s there was a growing number of domestic advice books, directed primarily at women and offering suggestions for every aspect of housekeeping. One author, Miss Leslie, published a very practical volume, *The House Book,* with a number of suggestions for coping with cold drafts indoors. Thick strips of wood covered with baize (a green woolen cloth) might be nailed to the outside of doors to serve as a sort of weatherstripping. Leslie also described seeing in "old fashioned houses" of the wealthy, "gilt or morocco leather, pinked or scalloped at the edge, tacked with gilt or brass nails round the crack of a door, and as it was considered ornamental as well as useful, it was left there all summer." She also described much simpler and more economical methods of forestalling drafts, such as "keeping the key always in the lock" and making long narrow bags of carpet or other thick cloth and filling them with hard sand before placing them against the threshold of a closed door.

Although the use of storm windows was not widespread before the late nineteenth century, several authors of domestic advice books in the 1830s, including Miss Leslie, point out such "double sashes" could be used in northern climates to increase efficiency in domestic heating. Others suggest pasting thick paper over cracks in window glass and frames or covering small pieces of wood with wool and placing them against the sides and bottoms of loosely fitting windows. Cracks were more commonly stuffed with wool or cotton batting or small pieces of cloth, but in the spring or during a temporary mild spell the wedges of wood were certainly easier to remove than were the sodden clumps of cloth or batting.

Heating and cooking stoves were known and available in New England in the last half of the eighteenth century, but few were used until the decades after 1820. It is not altogether clear why stoves began to be more widely manufactured and accepted after this date, but we know that from that time they were used in rural areas as well as in cities. Newspaper editors and stove manufacturers and dealers urged the adoption of stoves for their increased efficiency and more reliable heat. Many small foundries started casting stoves and a flood of new designs with technological improvements and decorative variations began to revolutionize domestic heating. Mrs. Royall Tyler may have summed up the feelings of many when she wrote that she felt "disposed to vote for a monument to the memory of the first inventor of family stoves; truly the people of this age know little of the horrors of winter."

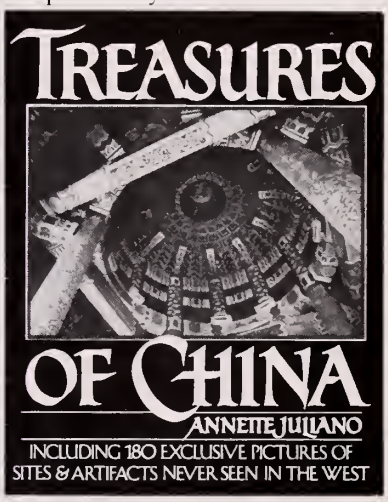
For all the hardships and inconveniences of a New England winter, it was a time when the rigor and tempo of agricultural work slackened somewhat and people of all ages could look forward to the pleasures of sociability, reading, and indoor recreation. Ample snow meant good sleighing, coasting, and skating. Many agreed with the author who, looking beyond the cold, saw that winter was a season "capable of being so passed, as to give a great deal of instruction, health and pleasure. It is a good season for social visiting and particularly favorable for reading, study and needlework. Then, too, it has our venerable Thanksgiving holyday." Winter has never been easy, but it is much more than shivering and hard work. □

Masterworks no Westerner has seen before.

This book is a rare event. More than 300 specially commissioned full-color photographs capture the splendor of China's finest palaces, temples, gardens and museums. Provided exclusively for this book by the government of the People's Republic of China, well over half of them are shown here for the first and *only* time. In no other book is the abundance, the glory, the *scope* of Chinese art presented with such variety from so many dynasties and places.

Supported by an illuminating text that explains the history as well as the significance of each artifact and site, TREASURES OF CHINA is a unique introduction to the wonders of the vast and largely unknown culture that is perhaps the greatest in the world.

In a deluxe, oversize format, at bookstores or send this coupon today.



Richard Marek Publishers, Inc.
A member of The Putnam Publishing Group
1050 Wall Street West
Lyndhurst, New Jersey 07071 NH

Please send me_____copy(ies) of TREASURES OF CHINA @ $35.00 plus $1.65 postage and handling per book. Enclosed is my ☐ check ☐ money order
Please charge my ☐ VISA ☐ Master Charge
#_____ Exp. date_____

Signature_____

Name_____

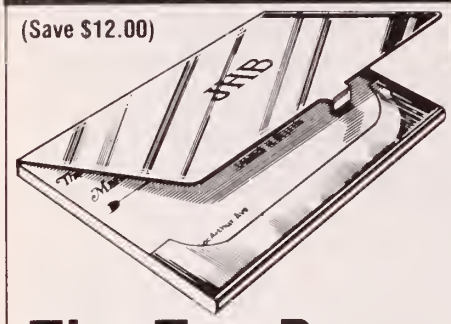
Address_____

City_____

State_____ Zip_____

Look-alikes Sell For ~~$20~~ Now! SALE PRICED at $7.98

(Save $12.00)



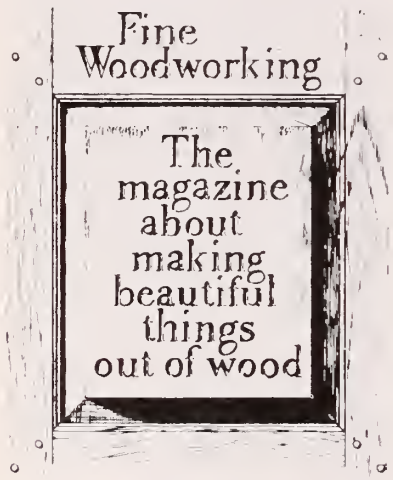
The Top-Brass CARD HOLDER

What a classy impression you'll make — drawing your business cards, credit cards, or ID's from this elegant, efficient case! Keeps cards clean . . . neat . . . together. Handsomely covered in status satin brass, with the option of your initials engraved for the final prestige touch. Slim 2¼" x 3⅜" to fit in pocket or purse. Sensational gift, too! Order today! **Engraved cases** (#422): State your 3 initials and add $2.00 to below prices for each holder engraved. **Plain cases** (#430): 1/$7.98 + $1.25 postage and handling; 2/$14.88 + $1.75 p/h; 3/$21.97 + $2.25 p/h; 4/$28.97 + $2.75 p/h; 5/$35.95 + $3.25 p/h; 6/$41.97 + $3.75 p/h. NY residents add sales tax. MC/Visa welcome (Card #, exp date), (914) 562-5177.

SATISFACTION GUARANTEED

ROYAL HOUSE, Dept. RCH1244,
137 Walsh Ave. • Box 4305 • New Windsor, NY 12550

© 1981 Royal House



Woodworker's delight—A subscription to *Fine Woodworking* brings you an abundance of ideas and information on cabinetmaking, carving, marquetry and turning—the tools and techniques, materials and design. Each issue is carefully edited and beautifully printed. Join the 200,000 readers of this superb bimonthly magazine by sending your name and address, along with your payment, to The Taunton Press, 52 Church Hill Road, Box 355CV, Newtown, CT 06470. One year $14, two years $26, refundable. For gifts, please include both addresses. Visa or MasterCard accepted.

House Warming

How an old farmhouse was insulated and heated to stay warm in cold weather

by Edwin Kessler

Eight years ago, my wife and I decided to leave the small city of Norman, Oklahoma, where I work, and move to the country, where we could be close to the land. In September 1973 we bought a farm in Purcell, about sixteen miles southwest of Norman. Situated on 215 acres, the original house, built in 1904, was uninsulated, had no central heating system, and consisted of three rooms—a bedroom, a kitchen, and a dining-living room. Successive owners had added kitchen plumbing, a bathroom, a laundry area adjacent to the kitchen, a small room that served as a bedroom, and a porch. When we moved in in 1974, the dining room, kitchen, and bathroom had propane stoves.

Siding of composition board and asphalt tile had been added to the outside over the years and the interior walls had been finished with Sheetrock and wallpaper. Nevertheless, there were many openings through which winter winds made their presence known. To maintain a comfortable temperature on cold, windy days, it was necessary to turn all three stoves up high.

During the early summer of 1974, Herbert Prater, a local Baptist preacher and carpenter, examined the house at my request and pronounced it basically sound. I then asked him to renovate the interior and insulate the house. The original ceilings were more than eight and a half feet high, one-half to one foot higher than is standard in modern construction. Their height allowed us to make alterations with unusual insulation qualities.

Prater placed studs around the room perimeters and laid ceiling joists, as is customary with new construction, but below the old ceiling. Fiberglass insulation was then installed in the walls and ceilings. The result was double walls and double ceilings with insulation exceeding that common in new construction. During the remodeling, most of the original window dimensions, 2½′ by 4′, were retained, but the traditional window sashes were replaced with storm windows, and storm doors were installed at the front and rear entrances.

We moved in when the remodeling was finished and found during the following winter of 1974–75 that sufficient heat was provided by just one propane stove—the one in the dining room. Accordingly, we removed the other two stoves, thereby gaining additional floor space, saving some money, and enhancing our safety and convenience.

In 1975, we contracted with Prater to make further changes. Six hundred and fifty additional square feet were added to the house, to include a second bathroom, a study, and a living room, all insulated, of course, and equipped with storm windows. A beautiful brick corner fireplace was built in the new living room with a fan-driven Heatilator to circulate room air around the firebox and back into the room again.

Storm windows bear directly on energy efficiency, costs, and comfort.

Edwin Kessler



A wood-burning cast-iron stove, which replaced the brick fireplace in the living room, uses less wood and is more heat efficient.

More than half the total heat loss in a house in winter can come from closed but ill-fitting windows. Tight construction with a double window sash can cut this heat loss by 50 percent or more and thus reduce overall heat loss by 25 percent or more, while decreasing the temperature differences between windows, floors, and ceilings. In addition, storm windows help maintain significantly higher humidity inside the house in winter. This is desirable because extremely dry interiors can cause respiratory discomfort and aggravate such illnesses as head colds and influenza.

The inner surface of a single window acquires a temperature only a little higher than that of the outside air and transmits that temperature to the interior air. Interior air cooled by contact with the window then deposits most of its moisture on the inside of the window in the form of water drops or even ice. When the cooled room air circulates away from the window area, it is warmed by mixing with other room air, but there is rarely a moisture source elsewhere in the room comparable to the "sink" at the window. This condition is largely alleviated by installing a double window because the inner glass surface presents a higher temperature than the outer glass, and condensation on the inner window is correspondingly reduced.

We installed electric resistance heaters (akin to the burners of an electric stove but containing fans) in the walls, for use as an emergency heating backup. In the new, approximately 420-square-foot living room, there is now a 4-kilowatt electric heater, but this alone is not large enough to maintain a comfortable temperature on cold and windy days, and it costs twenty to twenty-five cents per hour to operate. The fireplace could heat nearly the whole house above 72°F under practically any conditions of outside cold; but wood-burning rates on cold days were about ten pounds of wood per hour. While there is plenty of wood on our farm, it has to be cut, hauled, and stacked. Also, fires have to be fed and ashes have to be removed. In view of the time and effort involved with so much wood, we usually hung a blanket in the hallway joining the old and new parts of the house to prevent circulation of air, and during the winter we used the new living room and fireplace only when we had guests.

A fireplace radiates heat and a Heatilator makes an additional contribution

SALE! Thousands sold at $15. and over only $9.88

LET LOGTRAM LUG YOUR LOGS!

Enjoy Your Fireplace To The Fullest With *Safe, Convenient* Transport And Storage



Stop breaking your back . . . messing your floor

Bravo! Another dirty, uncomfortable job gone forever. This handy Logtram log lugger *manhandles* the heaviest hardwood pieces, *effortlessly*. Carts three to four armloads in one quick trip . . . with no sprained muscles, snagged clothing, or debris on the floor. Big, thoughtfully designed carriage rack is easy to load.

Oversized wheels practically 'walk' up stairs. Compact styling lets Logtram double as a dandy, *moveable* fireplace bin. Durable metal construction in handsome brass'n black finish. Disassembles for convenient off-season storage.

Logtram (Z477968)
SALE Only $9.88

ORDER NOW for quick delivery!

OLD VILLAGE SHOP
NO-NONSENSE
GUARANTEE
You must be delighted with your double-duty Logtram log carrier. You must agree it is a thoughtfully engineered, quality-constructed piece of equipment . . . or return it for a prompt full refund of purchase price—no questions asked! We guarantee it . . . in writing!!

Old Village Shop,
Hanover, PA 17331

SATISFACTION GUARANTEED! ORDER TODAY!

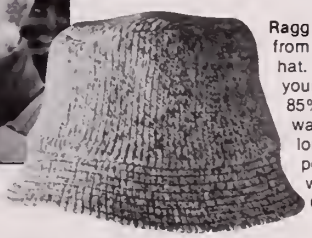
OLD VILLAGE SHOP, Dept. VZ-7536
340 Poplar St., Hanover, PA 17331

Please rush _____ Logtram Log Carrier(s) (Z477968) at the low, direct-to-you price of only $9.88 each plus $3.00 heavyweight shipping and handling on Full MONEY BACK GUARANTEE.
Enclosed is $_____ (PA residents add sales tax)
CHARGE IT:
☐ American Express ☐ VISA/BankAmericard ☐ Carte Blanche
☐ Diners Club ☐ Master Charge Interbank No. _____
Acc't No _____ Exp. Date _____
PRINT NAME _____
ADDRESS _____
CITY _____ STATE _____ ZIP _____
We ship within 48 hours; delays notified promptly. Delivery guaranteed within 60 days.
© Old Village Shop 1979

RAIN-SHEDDING RAGG WOOL



Ragg Wool Balaclava is styled like headgear worn by the British in the Crimean War. Today, it's the choice of backpackers, sailors and cross-country skiers. Undyed Ragg yarn is spun of 85% lanolin-rich wool for warmth and water repellency plus 15% nylon for strength. Balaclava folds up like a watch cap or turns down to cover your ears, chin and neck. Eye-shading visor. One size fits all. **Color:** Salt & Pepper. **Ragg Wool Balaclava $7.50** ppd.



Ragg Wool Slouch Hat takes its shape from the "bucket crown" Irish field hat. It hugs your head and shields your eyes from drizzle or sun. Knit of 85% wool with natural lanolin for warmth and water repellency, 15% long-life nylon. Folds for tucking in pocket or glove box, unpacks wrinkle-free. One size fits all. **Color:** Salt & Pepper. **Ragg Wool Slouch Hat $13.95** ppd.

Order Today! Money Back Guarantee!

Here is my check or money order for $_____
(Add sales tax where applicable.)
Please charge my ☐ MasterCard ☐ VISA
☐ American Express Good Thru _____
Card No. _____

☐ #1994 Ragg Wool Balaclava

☐ #1996 Ragg Wool Slouch Hat

☐ Please send me your FREE color catalog of more than 600 quality outdoor products.

Name _____
Address _____
City _____
State _____ Zip _____

Stores throughout the United States and Canada

Eddie Bauer®

Dept. LNH, Fifth & Union, Seattle, WA 98124

Telescopes from Celestron®

Will Take You To Places You've Never Been To Before
• Versatile • World's Largest Selection • Supremely Affordable



With a Celestron, the modern standard of high quality, affordable telescope performance, you can explore the craters of the Moon, the rings of Saturn, twirling galaxies and glowing nebulae. You can easily use a Celestron to photograph and view terrestrial subjects.

All Celestron telescopes have laser-tested, diffraction limited optical systems with hand-figured optics made in the U.S.A.

Celestrons® are available from 1.2- to 14-inches in diameter including the world's most popular modern telescope, the versatile Celestron 8. And, remember, most 35mm cameras easily attach to the Celestron for photography.

Free 8-page brochure or send $3.00 for 52-page full-color catalog on how to select and use a Celestron telescope/telephoto lens.

Celestron® International
2835 Columbia St., (Box 3578-NH2), Torrance, CA 90503, U.S.A. Telephone: (213) 328-9560

Dealer inquiries invited.



ARCHEOLOGY TOUR TO MEXICO **January 11-29, 1982**
ANCIENT MAYA ARCHEOLOGY **February 1-18, 1982**

Discover the ancient civilizations and archeology of pre-Columbian Mexico and the Maya world with the American Museum's C. Bruce Hunter. Sites on the Mexican tour include Mexico City, Cuicuilco, El Tajin, Jalápa, Cholula, Teotihuacan, Tula, Oaxaca, Mitla, Monte Alban, Cuernavaca, Xochicalco and Taxco. The Maya tour includes visits to Merida, Dzibilchaltun, Chichen Itza, Tulum, La Venta, Palenque, Edzna, Uxmal, Sayil, Xlapak and Labna. Tours include colonial towns, museums and the finest accommodations, and are limited to 18 participants. C. Bruce Hunter is Lecturer in Archeology at the American Museum, and author of A Guide to Ancient Mexican Ruins and a Guide to Ancient Maya Ruins. For further information write to DISCOVERY TOURS, American Museum of Natural History, Central Park West at 79 St., NY NY 10024, or call (212) 873-1440.

to the warming of room air. (Our Heatilator was a metal firebox in lieu of a traditional brick lining. Openings faced the room on each side at floor level and above the fireplace. Fans installed behind the lower openings sucked cold air in from the floor and blew warmed air back into the room from the top openings.) The contributions to heat gain from a fireplace, however, are more or less offset by the loss of room air that is drawn up the flue. The warmed air is replaced by cold outside air that enters through cracks anywhere in the house. This effect cannot be prevented—a house that is airtight except for its flue cannot support a functional fireplace and will fill with smoke. Thus some fireplaces actually cause the average house temperature to fall when they are in operation. To alleviate this, at least in part, it is good practice to provide a source of outside air at a point near the fireplace.

Fireplaces are most efficient when the damper is as nearly closed as it can be without creating a pall of smoke, but even then they are not remarkably efficient. Some improvement can be achieved by covering the front of the fireplace. Glass doors with control vents are available for this purpose.

In an effort to improve the efficiency of our fireplace, I hung steel plates over the front from pegs welded to the top. Similar to glass doors but much less costly, these noticeably reduced the draft and provided a measure of safety at night when the fire was left burning but unattended. Nevertheless, the burning rate required to maintain a comfortable temperature was reduced only about 25 percent. Furthermore, the plates were inconvenient because one of them had to be removed in order to add wood, and I was apprehensive that a malfunction in the Heatilator fans might allow the firebox temperatures to rise to dangerous levels. So the plates were used with caution.

Finally I decided to remove the entire fireplace and replace it with an airtight, cast-iron, wood-burning stove. This entailed a great deal of work, considerable additional cost, and made a mess in the living room. Our beautiful corner fireplace and chimney were dismantled brick by brick, but we now have approximately 1,000 clean bricks awaiting another use.

We think we did the right thing. With less than half as much wood, our cast-iron stove provides more effective heat

than the corner fireplace. This is mainly because the infiltration of cold outside air is vastly reduced. Also, a larger part of the stove heat comes from radiation, rather than from forced ejection of hot air, which tended to produce a concentration of warm air on the ceiling. Since no fans are involved, the stove uses no electricity and is silent. In addition, its operation is not subject to power failures. Less than half as much wood as before needs to be cut, hauled, stacked, and fed to the fire, and less than half the quantity of ashes needs to be removed. During winter, the stove fire is typically kept burning continuously for several days or even a week between mild spells, and is stoked only three times a day—in the morning before I leave for work, in the evening when I return, and just before retiring. The blanket that formerly hung in the hallway is now only rarely used. Our use of the propane stove in the old part of the house has been reduced by virtue of the wood stove because cold air does not enter that part of the house around the edges of the blanket. Except on a few rare occasions, we turn off the one propane stove in the dining room before retiring, and a slow fire in the wood stove maintains a comfortable sleeping temperature throughout the night.

When our corner fireplace was in use, we found that substantial temperature differences developed between floor and ceiling. Therefore, with the advice and assistance of a neighbor, I installed a six-inch-diameter duct that ran from just under the living room ceiling, down a closet wall, and then horizontally under the floor. A fan below the living room ceiling drew warm air off the ceiling and blew it through the duct to a vent in the living room floor. The living room was thereby made much more comfortable. Temperature differences are not as great with the cast-iron stove, but after the stove was installed I modified and extended the duct to transfer heated air from the living room to the old part of the house. By this means, the wood stove can be used more effectively to heat several rooms. Since the duct runs under the house, it is heavily insulated to preserve the warmth of the room air. If the duct had been placed in a paneled enclosure along the ceiling next to a wall, it would not have required insulation and would have been even more efficient than our under-the-house duct.

Heat loss through a floor can be large or small, depending on house construc-



The 1982 Program

Stimulate your mind on a Questers nature tour. We search out the plants and animals, birds and flowers...and explore rain forests, mountains and tundra, seashores, lakes and swamps. There is ample time to photograph, absorb, reflect. Naturalist guides, small tour parties, first-class accommodations.

Worldwide Nature Tours
1982 Departures

The Americas

Everglades: 11 days, Apr. 8, Nov. 4 • Hawaii: 15 days, Feb. 14, Mar. 21, Oct. 10, Dec. 19 • Alaska: 17 days, June 12, 26, July 10, 24, Aug. 7 • Pacific Northwest: 12 days, June 20, Aug. 1 • Superior Forest Canoe Trip: 9 days, July 10, Aug. 14 • Northwest Canada: 16 days, July 2 • Churchill: 11 days, July 17 • Newfoundland: 16 days, June 13 • Baja California: 11 days, Apr. 16, Oct. 15 • Southern Mexico: 14 days, Feb. 14, Dec. 19 • Costa Rica & Panama: 16 days, Feb. 13, Nov. 20, Dec. 18 • The Amazon: 17 days, Jan. 17, May 9, July 4, Aug. 8, Oct. 10, Nov. 14 • Galapagos: 15 days, Jan. 28, Apr. 22, July 15, Aug. 5, Oct. 28 • Peru: 23 days, July 17, Nov. 6 • Patagonia: 21 days, Nov. 6 • Trinidad & Tobago: 11 days, Mar. 8, Nov. 8.

Europe

Iceland: 16 days, June 11, July 2, Aug. 6 • Islands Highlands of Scotland: 21 days, May 27, July 15, Aug. 19 • Switzerland: 17 days, July 16, Aug. 13 • Greece: 19 days, Mar. 29, Sept. 20 • Spain: 20 days, Apr. 16, Sept. 3

Asia and Africa

Israel: 16 days, Mar. 15, Oct. 18 • The Himalayas: 23 days, Mar. 18, Oct. 7 • India: 23 days, Jan. 30, Oct. 30, Nov. 27 • Sri Lanka: 18 days, Feb. 19, Nov. 19 • Kenya: 23 days, Feb. 4, July 22, Oct. 21 • Zimbabwe & Botswana: 19 days, July 8, Aug. 5

Australasia

Australia & New Zealand: 30 days, Feb. 13, Oct. 2 • New Zealand & the Milford Track: 22 days, Feb. 12, Nov. 12 • The Complete Australia: 35 days, Sept. 3

To learn more, write requesting the 1982 Directory of Worldwide Nature Tours. Indicate if you are interested in any particular tour and we will send the corresponding Detailed Itinerary



QUESTERS

Questers Tours & Travel, Inc.
Dept. NH, 257 Park Avenue South
New York, NY 10010 • (212) 673-3120

I'm right here in America– and I need you for a friend.

Annie is typical of many American Indian children who may not stay in school without the help you can give.

She's bright as a button. But her father can't find permanent work and her mother must care for brothers and sisters who live with her on an Arizona reservation.

Her family and tribe are proud of Annie's progress in school and they want her to finish. And now, happily, she has a Futures sponsor—someone like yourself—who will help make it happen.

But there are many other Annies: school-age girls and boys on reservations who need your help.

Through Futures for Children you can sponsor one or more of them. Your contribution of $20 a month will buy new jeans, shoes, a warm coat for cold winters, personal items, school supplies, and much more. *And you'll enrich your own life in coming to understand a different culture—right here in the United States.*



So you don't have to look far to find a child who needs your help. You'll receive a picture of your Indian child, a personal history, and lots of information about life in Indian America. What a thrill to get that first letter from your Indian child! Write your check to Futures today. Please send it with the coupon below.

_____ I want to sponsor an American Indian child ☐ boy ☐ girl ☐ either
Enclosed is a check for $_____ ($20 monthly, $60 quarterly, $120 semi-annually, $240 annually)
_____ Can't be a sponsor now, but I'd like to help your program. Enclosed is my tax-deductible donation of $_____ NH1081
_____ Send me more information about sponsoring an American Indian child
_____ Let me help your community program for Indian parents. Here is my contribution of $_____ and please send me more information.

Name _____
Address _____
City _____ State _____ Zip _____

Futures For Children *(All contributions are tax deductible.)*
4401 Montgomery Blvd. N.E. #194 Albuquerque, N.M. 87109 Toll Free (800) 545-6843 In New Mexico (505) 881-6616

THE FAMOUS ENGLISH BOBBY WHISTLE NOW AVAILABLE IN AMERICA!



Scotland Yard uses it to blow the whistle on crime you'll use it for safety to hail cabs even as a fashionable pendant! Hang on your keychain, too!

This is the very same whistle issued to Scotland Yard and the English police. In many instances, it is the only weapon they carry. Yet the whistle's shrill warning is enough to send shivers down a criminal's spine. Carry it to and from work for safety's sake. Keep one in the glove compartment of your car. And there are other practical reasons for owning one. It's a great way to hail a taxi, keep track of kids at the beach or hiking. And it even makes a fashionable pendant! Nickle-plated brass. At only $4.98 can you afford not to own one?

One for $4.98 plus 65¢ postage & handling. Two for $8.88 plus $1.10 postage and handling.
(NY residents add sales tax)

SATISFACTION GUARANTEED

Royal House, Dept. RBW1259,
137 Walsh Ave. • Box 4305 • New Windsor, NY 12550

Custom Printed FROG Stickers



(shown half-size)

This lively green Frog sticks at a touch to paper, leather, wood, glass, plastic, cloth or metal. Carefully printed in clear, readable type and cut to Frog shape.

With an address, a short message or just a few words: 100 for $5.90 or 200 for $8.70. Please add 80¢ postage and handling. Also, 20 Frogs printed with "Have a Hoppy Day" for $1.40 ppd.

FROGS, BOX 735-T, ACTON, MASS. 01720

BOOK HUNTING?

Virtually any book located—no matter how old or long out-of-print. Fiction, nonfiction. All authors, subjects. Name the book—we'll find it! (Title alone is sufficient.) Inquire, please. Write: Dept. 71

**BOOKS-ON-FILE P.O. BOX 195
UNION CITY, NEW JERSEY 07087**

The Wilderness Travel World of Discovery



WINTER/SPRING NATURE TOURS TO:

• *Kenya* • *Tanzania* • *Galapagos* •
• *Costa Rica* • *Ecuador* • *Peru* •
• *Falkland Is.* • *Patagonia* • *The Amazon* •

Expert Naturalist Guides Very Small Groups
Write for free illustrated catalog

WILDERNESS TRAVEL
1760-GP Solano Ave., Berkeley, CA
(415) 524-5111 94707

tion. Floor losses are small in Oklahoma in homes built on slabs because the ground here is warm, even in winter. (The average annual ground temperature in central Oklahoma is 60°F, compared to the average of 50° near New York City.) When a house is built on fieldstone, as ours is, and has a crawl space under the floor, as ours has, heat loss through the floor depends on insulation and on the temperature in the crawl space. Since the fieldstones of our house foundation are only loosely cemented, there was a strong draft of cold air under the house on windy winter days. Previous owners had reduced the draft by placing bales of hay along the foundation on the north side of the house. I discontinued this practice because I considered it a fire hazard. Instead, I went to some effort with sheet metal and plywood to seal the exterior of the foundation, and our new siding, which extended over most of the foundation, also helped.

The floor area of a one-story house is about one-half to three-fourths the wall area from floor to ceiling, and after the improvements, I estimated the heat loss through the uninsulated floor to be about a third of that through the original uninsulated walls, excluding windows. Finally, I insulated the floors by stapling lengths of fiberglass between the floor joists. Owing to restricted crawl space, the task was difficult, but the results were gratifying. The floor temperature inside the house rose noticeably, and temperature differences and drafts from room to room within the house were further reduced. Insulating the floor substantially increased our comfort while further reducing the energy required to heat the house.

I have made several solar energy devices that contribute to our comfort while reducing our energy bills. The south-facing wall of our small TV room-guest bedroom-daytime lounge is only slightly obstructed in winter by leafless black locust trees, and so is used as the collector surface for a solar heater. This heater is little more than a frame of 2″ by 4″ lumber attached to the exterior wall and covered with a fiberglass reinforced panel that transmits nearly all of the light incident upon it. At the lower east end of the collector is a four-inch-diameter hole through which a 14-watt fan blows air from the floor of our dining room. The air returns to the guest bedroom through a four-inch hole in the wall at the upper west end of the collector. The vertical orientation of the col-

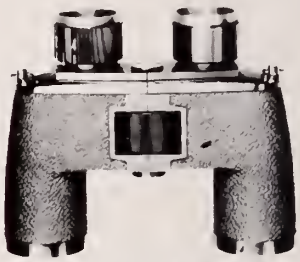
AUTHORS WANTED BY NEW YORK PUBLISHER

Leading subsidy book publisher seeks manuscripts of all types: fiction, non-fiction, poetry, scholarly and juvenile works, etc. New authors welcomed. Send for free, illustrated 40-page brochure W-82 Vantage Press, 516 W. 34 St., New York, N.Y. 10001

HIMALAYA
TREKKING AND WILDERNESS EXPEDITIONS

Physical and cultural quests for the spirited adventurer in remote CHINA, TIBET, NEPAL, KASHMIR, NEW ZEALAND, JAPAN, and more.

For a beautiful TRAVEL PORTFOLIO detailing more than 20 unique trips around the world SEND $2 to 1802-N Cedar St., Berkeley, CA 94703.



BUSHNELL 7x35 CUSTOM
Mfg. List $280.00 Postpaid $164.00

This is an example of the deep discount prices on high quality optics that is found in our FREE catalog. This catalog lists and illustrates an outstanding selection of telescopes, binoculars etc., plus valuable information on how to properly select them. Write for it today.

GIL HEBARD OPTICS
COURTHOUSE SQ., KNOXVILLE, ILL. 61448

PERU
CUSCO — MACHU PICCHU
THE AMAZON

The largest variety of tour packages including First Class and Delux hotels, at the lowest price ever.

CALL NOW—TOLL FREE 1-800-223-1367
IN N.Y. CALL COLLECT (212) 582-7811
VALISHA TRAVEL
250 W. 57th. St.
N.Y.C. 10019

lector provides for automatic cutoff in the warm season when the sun rises and sets toward the north and passes nearly through the zenith. On a clear winter midday, this heater typically produces a temperature rise of 60 degrees (from 60° to 120°) in air flowing at a rate of seventy-five cubic feet per minute; this represents more heat than is delivered by a one-kilowatt electric heater. On practically all sunny winter days the solar heater alone assures comfort in the 8′ by 10′ room it serves, and while it is in operation, the propane stove in the adjoining dining room is either turned down very low or turned off. With the use of some recycled components, this solar heater was built for less than $100.

The economic effects of our conservation efforts are illustrated by data on our use of propane and electricity, especially in relation to the expansion of facilities on my farm. When my wife and I moved into our farmhouse in September 1974, it comprised 850 square feet. We added 650 square feet during 1975. In 1976, we built a 720-square-foot guest cottage and we have also installed new irrigation and refrigeration units. Propane deliveries were 905 gallons in 1975, partly a result of heavy usage during 1974. In 1979, following the coldest winter on record in central Oklahoma, when temperatures from December 1978 through February 1979 averaged about 31°, as compared with the usual 39°, 736 gallons of propane were delivered; in 1980, only 330 gallons. Annual usage of electricity was 8,070 kilowatt hours in 1975, and peaked at 9,515 kilowatt hours in 1977. During 1980, usage was only 7,509 kilowatt hours, in spite of a summer even hotter than the hottest of dustbowl days, with temperatures averaging near 88° instead of about 82° and requiring heavy use of fans, refrigerators, and water pumps. Our use of electricity and propane in 1981 up to this writing has continued at satisfactorily low levels. And since we installed the woodburning stove, we have, of course, used wood—about two cords per year. (Summer usage of electricity has been kept low by means of evaporative coolers and solar devices.)

With electric bills of approximately $30 per month and expenditures of about $200 per year for propane, our energy costs are substantially below those of less energy efficient houses; at the same time we are living in as much, or perhaps even more, comfort than most people. □

What your home could have in common with the Met, the Tate, and the Louvre.



Helen Rundell's *Shelter Island*, original lithograph. Signed limited edition of 175.

Beautiful, original works by artists who are represented in the world's great museums and galleries can be yours for very reasonable prices.

We offer original etchings, lithographs and serigraphs signed by Calder, Chagall, Dali, Miró, Renoir, Vasarely and other important artists.

Helen Rundell's serene lithograph, *Shelter Island*, is one of the many fine prints we've made available.

Our expert advice and full money-back guarantee are your assurances that the art you buy will have lasting value and beauty.

Send for our colorful, descriptive catalogue, without obligation.

Original print collectors group, Ltd.

215 LEXINGTON AVE., DEPT. NH-33, NEW YORK 10016

PLEASE SEND ME YOUR FREE COLOR CATALOGUE AND LATEST NEWSLETTER.

NAME _____
(PLEASE PRINT)

ADDRESS _____

CITY _____ ST _____ ZIP _____

© 1981 OPCG, LTD



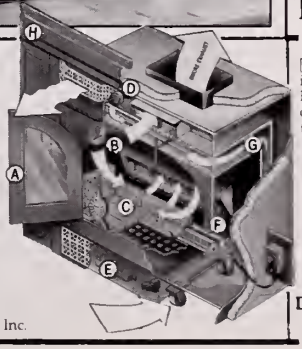
Save Your Fireplace!

Those crackling flames can lift your spirits, but your open fireplace actually *wastes* more heat than it delivers. Perhaps you've discovered that tubular grates, glass doors and ordinary fireplace inserts offer only a partial solution at best. Yet a black metal woodstove on your hearth would be an affront to your room decor.

Efficiency on wheels

The Shelburne can transform your fireplace into a super-efficient heat producer without compromising the visual and soul-warming pleasures it provides. You enjoy a visible fire behind safe Corning Pyroceram glass. Downdraft combustion, 2000°F space-capsule insulation and a 40" baffle system help account for its amazing performance. And the Shelburne *rolls out* on your hearth for easy chimney cleaning.

The Shelburne Fireplace-Stove



(A) Doors may be opened to view the fire (B) Air is preheated as it enters downdraft and secondary air tubes (C) Firebrick-lined ¼" steel firebox (D) Automatic thermostat (E) Pullout ash pan (F) Fan with speed control (G) 40" baffling system (H) Flanges in choice of 3 widths permit installation in over 80% of all fireplaces.

Patents pending
© 1981 Vermont Stove Co., Inc.

☐ Rush me your Information Portfolio including complete details on the new Shelburne Fireplace-Stove, insulation sample swatch, and direct-from-manufacturer prices. Enclosed is $1 to help cover mailing costs.

Name _____

Address _____

Zip _____

The Vermont Stove Company

Dept. 241A, Route 7, Shelburne, Vt. 05482

(802) 985-2592

Indoor Air Pollution

Your cozy fireplace may involve risks you do not know about

by Colin High

If you live in a cold climate, where frigid night winds blow in one side of your house and out the other and your heating bills make you think you must be heating the whole outdoors, you probably realize a wise move would be to fill in the cracks and cut down on the drafts in the house. There is no doubt that for the average older home, reducing the air-infiltration rate, by caulking, weather-stripping, and installing storm doors and windows, is the most cost-effective way of reducing winter heating bills. In areas of high heat costs in the northern states, many kinds of weatherproofing repay their expense in one or two heating seasons.

But as more and more homeowners wisely save energy by sealing up the cracks in their houses, another problem is giving them cause for concern, namely, indoor air pollution. A house may contain numerous potential sources of gaseous and particulate air pollution, such as smoke and/or particles from cigarettes, a working fireplace, a wood-burning stove, or a gas cooking stove. As the rate of air exchange between the inside and the outside of the house is reduced, the possibility that some or all of these pollutants will accumulate is increased.

Indoor air pollution is not a new phenomenon. On the contrary, today's houses are probably far more healthful than those of a century ago, when open fires and poorly ventilated coal- and wood-burning cookstoves created high levels of indoor air pollution. In particular, housewives working in the kitchen may have been exposed to more than their fair share of pollution. The quality of the air in pioneers' huts, Indian tepees, and sod houses, which were often built without chimneys, was certainly far worse than the quality of the air found in modern houses. Fortunately, the inhabitants of the earlier structures spent a good deal of their time outdoors. Today, however, much more time is spent indoors, especially in the winter, and young children may spend most of their time inside the house.

The problem of indoor air pollution has only recently been recognized. That recognition began when skyrocketing fuel prices drove homeowners to employ energy conservation measures that, in turn, often reduced the air-exchange rates in the houses. The open fireplace, the traditional heat source and symbol of warmth, comfort, and hospitality, is probably the most serious cause of indoor air pollution. Wood and coal fires release high concentrations of very small particles, including ash and unburned hydrocarbons. The most worrisome of these particles are the small polycyclic organic materials, known as POMs, whose molecules are arranged in rings. The general class of POMs includes more than a thousand identifiable organic compounds found in wood, coal, and cigarette smoke, and in auto and truck emissions. Many of these POMs, such as those from wood, coal, and cigarette smoke, have been found to be carcinogenic and therefore a serious cause for concern. Tests in some typical American homes with working open fireplaces show that concentrations of particulates, which include POMs, may be four or five times higher than they are outdoors. Wood stoves of the airtight variety, with controlled airflow and properly installed chimneys, release fewer particles into the house than fireplaces and, in consequence, are a less serious source of harmful indoor pollution. Considering that most Americans view an open fireplace as a desirable feature, it is ironic that this symbol of coziness has so little to recommend it from the point of view of health. Not only are fireplaces a serious source of indoor air pollution but they may also be



An airtight wood-burning stove, equipped with a properly installed chimney, releases fewer particulate pollutants into the interior of a house than an open fireplace does.

Robert Perron



a fire risk and burn hazard for children. In addition, the efficiency of open fireplaces is only one-third that of woodstoves. In very cold weather, an open fireplace operating at the same time as a conventional central heating system may actually draw more hot air up through the chimney and out of the house than the amount of heat it replaces by radiation.

Cooking on a gas stove produces both gaseous and particulate air pollutants. The good smells that emanate from the kitchen stove and draw the family around the dining table may be accompanied by other, less desirable vapors. There are two potential sources of pollution at the kitchen stove: the cooking or burning of food and the gas flames used for cooking. The process of cooking food releases gases and particles that include small quantities of POMs. Only occasionally, however, are the POM concentrations high enough to cause alarm, as when the burning of food creates a pall of blue smoke hanging below the ceiling. Of greater concern are the emissions of carbon monoxide and nitrogen oxides from gas cooking. Tests show that in some kitchens equipped with gas stoves, the level of nitrogen oxides may be five times higher than the level outdoors, and carbon monoxide levels are also higher. Both nitrogen oxides and carbon monoxide—caused outdoors primarily by motor vehicles—are recognized by the Environmental Protection Agency as serious pollutants that give rise to both acute and chronic health problems. There are, however, no national air quality standards for private homes. In houses where tests have been made, the federal ambient air quality standards for outdoor air are sometimes exceeded for particulates, nitrogen oxides, and carbon monoxide, even though the outdoor air quality has met the federal standards. These increased indoor air-pollution levels are largely attributed to open fireplaces, gas cooking, and cigarette and cigar smoking.

Air pollution from smoking is highly variable, and the subject is, of course, controversial. Cigarette smoke produces particulates, such as hydrocarbons and POMs, and is responsible for increased particulate levels inside private houses, offices, and public buildings. Due to the absence of open fires and cooking facilities, however, the air quality in offices and public buildings is usually better than that in homes and sometimes even better than that in the streets. Furthermore, most offices and public buildings have better ventilation and air-filtration systems than the average privately owned house.

Although particulates, carbon monoxide, and nitrogen oxides are the most common home pollutants, there are others that may also be a cause for concern. Painting, cleaning, and the projects carried out in home workshops often involve the use of volatile organic solvents that are components of paints, thinning agents, cleansers, and glues. The con-

Installing storm windows and siding serves to cut home heating costs, but as the rate of exchange between inside and outside air is reduced, indoor air pollution can become a real problem.



Donald Dietz/Stock Boston Inc.

Imported by The Paddington Corporation, New York, N.Y. 34 Proof © 1981



BAILEYS.
THE ORIGINAL IRISH CREAM LIQUEUR.

THE CREAM IS REAL. THE SPIRITS ARE REAL.
ONLY THE TASTE IS MAGIC!

Natural History magazine offers members and other readers a service of free information from advertisers and the American Museum of Natural History. To obtain material, simply fill out one of the adjoining postage-paid cards and drop it in any convenient U.S. mailbox. Just circle the numbers on the card corresponding to the numbers beside the names of the advertisers below in whom you are interested.

Natural History endeavors to check the credit and reputation of its advertisers. It expects all of its advertisers to engage in good business practices. These include prompt replies to queries and complaints and refunds when appropriate. If you have any difficulties with an advertiser in *Natural History*, please let us know so that we may try to help solve the problem and so that we may refuse to accept future advertising from any firm that repeatedly fails to satisfy our members.

Please allow up to six weeks for replies. If the postcard is missing, send your request to Member's Market, Post Office Box 2723, Clinton, Iowa 52735.

1. ADVENTURES INTERNATIONAL—Photographic and natural history trips to Africa; Australia, Canada, Mexico, Nepal, Sri Lanka and South America. Small groups. Expert leaders. Trip preview available.

2. AIC PHOTO/SOLIGOR—Free 32-page color brochure shows why Soligor Makes the Difference in fine zoom lenses for 35mm slr cameras.

3. ASTRONOMY MAGAZINE—Introduces you to the beauty and mystery of the universe with exciting, factual articles and dramatic illustrations.

4. AUDIO-FORUM—Foreign language self-instructional courses that work. Full-length tested book/cassette programs developed by U.S. State Dept.; Spanish, French, 23 other languages. Free catalog.

5. AUSTRALIAN TOURIST COMMISSION—If you're up for adventure, come Down Under. With low airfares, Australia welcomes you.

6. BARNES & NOBLE SALE ANNEX—Free monthly catalog offering thousands of brand new hardcover and paperback books, plus records, all at huge savings.

7. BENEDICTINE—Near-Perfect Party Planner. Sensational party ideas and drink recipes that will warm your hearts from Benedictine D.O.M. Liqueur.

8. BOODA PRODUCTS—Cat lovers. Catalogue of hard-to-find cat accessories and necessities. Includes new 100% odor-free litter pan and new electronic flea and pest repeller.

9. THE CALVIN COLLECTION—Fine art at its finest. Full-color catalog of genuine lithographs in limited edition by prominent artists from the U.S., France, and Italy. Signed, numbered, beautifully matted and framed.

10. CANON A-1—Free color brochure available covering the Canon A-1 camera and other fine Canon photo products.

11. CARL ZEISS, INC.—Send for free full-color brochure describing entire line of Zeiss binoculars.

12. CORNELL LABORATORY OF ORNITHOLOGY—Your membership invited. Members receive *The Living Bird*, newsletters, and invitations to seminars and field trips.

13. ECUATORIANA AIRLINES—Enjoy the best of South America with the airline of all the Americas. Send for free brochures.

14. EDDIE BAUER—Free, full-color catalog of hundreds of items: Premium goose down-insulated clothing, plus fieldwear, footwear, camping and hunting gear, accessories, indoor comfort items, gifts.

15. FUTURES FOR CHILDREN—Free information on programs this non-profit foundation operates to help American Indian children stay in school . . build futures for themselves.

16. HANNS EBENSTEN TRAVEL, INC.—Send for interesting Newsletter—listing many fascinating travel programs.

17. HIMALAYA—Offers the spirited, physically fit adventurer small group outings in remote, mountainous regions of Tibet, China, Kashmir, Nepal, Japan, New Zealand and more.

18. MEREWEATHER PRESS, INC.—We are the North American office of Lansdowne Editions of Australia, distributor of fine trade and limited editions on wildlife and horticulture subjects. Color brochures available.

19. MOUNTAINSIDE CONCEPTS—Energy Saving Products—including down-filled comforters, robes, slippers, jackets, vests and coats—from Mountainside Concepts.

20. MUSICAL HERITAGE SOCIETY—Membership information from the Nation's treasure house of obscure as well as familiar classical music.

21. NIKON PHOTOGRAPHIC PRODUCTS—Discover legendary quality and space-age technology in 35mm cameras, lenses, binoculars and accessories.

22. OXFORD GALLERY—We specialize in importing from England, prints of the artist, J.M.W. Turner (1775-1851). Some of the prints are unique to us. Prices approximately $15.

23. PENTAX—Write for more information on our full line of binoculars.

24. QUESTERS TOURS—Send for complimentary 1982 Directory of Worldwide Nature Tours from North America's leading natural history tour operator.

25. SOCIETY EXPEDITIONS—Cultural/wildlife expeditions and worldwide cruising. Small groups, expert lecturers. Antarctica, Amazon, New Guinea, Galapagos, China, Indonesia, Iceland/Greenland, Arabia, North Africa, Tunisia.

26. SRI LANKA—Discover our undiscovered, unspoiled island country. Ancient cities, misty mountains, miles of beaches, colorful festivals, more. A bargain paradise; a lifetime of memories. Tour booklet.

27. VALISHA TRAVEL—Peru the Ancient Civilization . . . The largest variety of tour packages to Peru, Cuzco, Machu Picchu and The Amazon. First Class and de luxe hotels. Send for free brochures.

28. WATERFORD CRYSTAL—Full color booklet on the hand made Irish Crystal famous throughout the world. Free booklet.

29. WILDERNESS TRAVEL—Wildlife and natural history tours, anthropology/archeology tours, trekking expeditions, jungle exploration. Africa, Galapagos, Peru, Alaska, China, Nepal, Australia. Expert leaders. Small groups. Free catalog.

30. WILDLIFE EDUCATION LTD.—ZOOBOOKS. Free, the first issue of a charter subscription to monthly ZOOBOOKS, an exciting series about animals for children and young adults. Full color, stunning wildlife photos, beautiful artwork, accurate information. Cancel at any time.

31. AMERICAN MUSEUM OF NATURAL HISTORY—Discovery Tours—Travel with Museum scholars to East Africa, Mexico, the Galapagos Islands, Indonesia, The Nile, The Adriatic and Aegean, Alaska, Morocco, and China.

Natural History Members' Market

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70					

Circle the numbers that correspond to those listed on opposite page. *Offer expires December 31, 1981*

Name_____ Title_____
(please print)

Address_____

City_____ State_____ Zip_____

Please take a moment to check the appropriate answer to the following questions.
This information is confidential.

1. AGE:
A ☐ 18-34
B ☐ 35-54
C ☐ 55 & over

2. SEX:
D ☐ M
E ☐ F

3. EDUCATION:
F ☐ Graduated College
G ☐ Attended College
H ☐ Graduated High School

4. OCCUPATION:
I ☐ Manager/Professional
J ☐ Professional/Technical
K ☐ Manager/Administrative
L ☐ Clerical/Sales
M ☐ Craftsman/Foreman
N ☐ Other

INCOME: **5. Household** **6. Individual**
Under $14,999 O ☐ S ☐
$15,000-24,999 P ☐ T ☐
$25,000-44,999 Q ☐ U ☐
$45,000 & over R ☐ V ☐

7. OWN
W ☐ 4WD Vehicle
X ☐ Video Rec./Player

8. MANAGE/PURCHASE
Y ☐ Corporate Funds
Z ☐ Office Equip.

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO. 217 CLINTON, IOWA

POSTAGE WILL BE PAID BY ADDRESSEE

Natural History
Members' Market

P.O. BOX 2723

CLINTON, IOWA 52735

tainers for these products warn users about the need for adequate ventilation, but that may be hard to provide in winter. Because many of these solvents are toxic and carcinogenic, they represent some degree of health hazard even though we do not yet know how serious occasional exposure to them may be.

Gaseous and particulate pollutants from gas stoves, cigarette smoke, cooking food, and other sources can accumulate in houses where caulking and weather-stripping prevent the leakage of indoor air.

Exposure to the fumes of various solvents is infrequent and the incipient pollution can be recognized by the smell; the problem presented by radon gas in the home, however, cannot be so easily dismissed. Radon, which is released by radioactive minerals, can enter private homes in very small quantities from rock basements and masonry materials used in construction. Odorless and colorless, radon cannot be detected by the occupants. The long-term health effects of exposure to trace quantities of radon gas are not known with certainty; nevertheless, there is reason to believe that exposure to this radioactive gas increases the risk of cancers. Most at risk are occupants of poorly ventilated homes with exposed rock or masonry



Dan McCoy/Rainbow

A Gift for Health



NordicTrack

Jarless Total Body Cardiovascular Exerciser

Duplicates X-C Skiing for the Best Motion in Fitness

Highly Effective and Pleasant To Use
The enjoyable sport of cross-country skiing is often cited as the most perfect form of C-V exercise. Its smooth, fluid, total body motion uniformly exercises more muscles and higher heart rates seem easier to attain than when jogging or cycling. NordicTrack closely simulates the same pleasant motion and provides the same cardiovascular endurance-building benefits — right in the convenience of your home. Makes a year round, consistent exercise program easily attainable. Eliminates the usual barriers of time, weather, chance of injury, etc. Also highly effective for weight control.

Better Than Running
NordicTrack gives you a more complete work out — conditions both upper body and lower body muscles at the same time. Fluid, jarless motion will not cause joint or back pains as jogging or running often does.

Better Than Exercise Bikes
NordicTracks stand-up skiing motion more uniformly exercises large leg muscles and also adds important upper body exercise. Higher pulse rates, necessary for building fitness, seem easier to attain because the work is shared by more muscle mass. The NordicTrack also keeps more muscles in tone.

Even Better Than Swimming
NordicTrack more effectively exercises the largest muscles in the body, those located in the legs and buttocks. These muscles main function is to lift and propel the body in the standing position. When swimming, the water supports the body thus preventing these muscles from being exercised as effectively as when they support the body in a standing position.

A Proven, high Quality Durable Product
Ruggedly constructed, NordicTrack is quiet, motorless and folds compactly for storage. Separate arm and leg resistances. NordicTrack is in its 5th year of production and is used in thousands of homes and many companies. We manufacture and sell direct. Our No-Risk 15 day trial guarantee shows our confidence in your being pleased with the performance and quality of the NordicTrack.

This year, give someone you love a gift for better health.

For more information, call or write
PSI 124 L Columbia ct. Chaska, MN 55318
toll free 1-800-328-5888, MN. 612-448-6987

basements built in areas of granitic or other igneous and metamorphic rocks.

Solutions to the problem of indoor air pollution are not difficult and are generally not unduly expensive. Proper ventilation is essential in all houses, even in winter. Specific sources of pollution can be dealt with individually. The solution to smoking is clear. Even if nobody in the household smokes, dealing with guests who do—and especially with large parties—requires tact and diplomacy. Perhaps the easiest solution is just to open the windows wide when smokers are present and hope your hospitality will keep everyone warm. The use of solvents really does require adequate ventilation. Painting and cleaning that depend on solvents should be reserved for warm weather, when windows and doors can be opened. Because radon gas is difficult to detect, preventive action is the best cure. Good ventilation and basement walls made of sealed or painted concrete should reduce or eliminate the buildup of radon gas within the home.

Eliminating pollution derived from cooking and from open fires presents harder choices. Giving up an open fireplace may be difficult for some people. Installation of a fireplace insert, which is like a stove fitted snugly into a fireplace opening and closed with metal or heavy glass doors, would enhance the heat from the burning firewood and reduce the amount of indoor air pollution. Wood or gas cooking stoves need adequate hoods and forced draft ventilation to the outside to prevent the buildup of pollutants, especially during the winter when most homes are sealed up against the cold. Other gas- or oil-burning appliances, such as furnaces and hot-water heaters, must also be adequately vented to comply with building codes. As energy costs rise, however, the need to conserve heat in the house and

As buildings of all kinds become better insulated and more airtight, effective ventilation systems will be required to control the quality of indoor air.



William Moriarity/Rainbow

Halls

for those with impeccable taste...

Halls Christmas Catalog

Dedicated to those who have a flair for choosing just the right gift for everyone on their list—Halls Christmas Catalog offers an unusual, exotic, and delightful selection of gift items. Unique imports, fashions and many exclusive items. Send for your Halls Christmas Catalog today.

Halls Catalog, Dept. 1499, 505 Armour Road, North Kansas City, MO 64116

Please send me a series of your catalogs starting with the big Christmas issue. I enclosed $2. to cover postage and handling

Name _____

Address _____

City _____

State _____ Zip _____

Phone Number _____

Halls Catalog A Subsidiary of Hallmark Cards, Inc.

CRUISE TO THE WORLD'S HIDDEN CORNERS.



Join discerning travelers on an unforgettable WORLD DISCOVERER Voyage.

The Amazon · Antarctica · New Guinea · Indonesia · Singapore/Burma/India/ Sri Lanka/Seychelles · Arabia · Iceland/Greenland · North & West Africa

14 to 76 Days. From $2,920 to $32,000.

Society Expeditions

Dept. NH10 723 Broadway East, Seattle, WA 98102

I'd like to explore the remote cruising opportunities of Society Expeditions, detailed in your 36 page cruise catalog.

NAME _____

STREET _____

CITY/STATE/ZIP _____

PHONE ( ) _____

YOUR TRAVEL AGENT _____

The MS *WORLD DISCOVERER* is registered in Singapore.

maintain good ventilation will probably mean increased home use of air–heat exchangers similar to those now used in some offices and public buildings.

Air–heat exchangers operate by blowing hot air out of, and sucking cold air into, a building. The exchanger is a box, about the size of an average window air conditioner, that is installed in a ventilation system. One motor in the exchanger drives a fan that blows hot air out over a partition made of treated paper or plastic; a second motor drives another fan that blows cold air in from the outside over the same partition. The partition separates the two airflows in such a fashion that heat from the indoor, used air is transferred to the incoming, cold air. The trick is to design the exchanger so that the heat can be transferred without transferring the indoor pollutants to the incoming air.

A number of air–heat exchange units for home use are now on the market. Some of these units are imported from Japan and Europe where high-cost energy has made home heat conservation as essential as it is fast becoming here. □





Exotic cinnabar egg makes extraordinary accent piece.

Exquisitely crafted cinnabar egg from Willoughby & Taylor's collection of world treasures makes an extraordinary accent piece or special gift. Created by careful layering of Chinese cinnabar lacquer, and accentuated by masterful carvings of Oriental characters and delicate flowers, it conveys a most exotic quality. The egg with its accompanying rosewood stand adds unique stature wherever you place it. 4" tall. Your satisfaction is always guaranteed, backed by our Lloyd's of London correspondents. Just $33.50 (including postage), from Willoughby & Taylor Ltd., 2912 Iron Ridge Road, Dallas, Texas 75247.

Send me _____ Chinese cinnabar egg(s) @ $33.50 each. 4R0329

☐ Cheque or money order enclosed.

Name _____ ☐ VISA ☐ MasterCard ☐ American Express

Address _____ ☐☐☐☐ ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

City _____ State _____ Zip _____ Exp. date _____

☐ YES! Please send me complete catalogue of international treasures free with my order. ($1.00 separately.)

Call Toll-free (800) 323-1718 for charge orders.

Willoughby & Taylor Ltd.
International Merchants
2912 Iron Ridge Road, Dallas, Texas 75247

In Illinois (800) 942-8881. Ask for Operator 102.

Speak French like a diplomat!

What sort of people need to learn a foreign language as quickly and effectively as possible? *Foreign service personnel*, that's who. Members of America's diplomatic corps are assigned to U.S. embassies abroad, where they must be able to converse fluently in every situation.

Now *you* can make a start on learning to speak French just as these diplomatic personnel do—with the Foreign Service Institute's Basic French Course.

The U.S. Department of State has spent tens of thousands of dollars developing this course. It's by far *the most effective way* to learn French at your convenience and at your own pace.

The Basic French Course consists of a series of audio cassettes and an accompanying textbook. You simply follow the spoken and written instructions, listening and repeating. By the end of the course you'll find yourself learning and speaking entirely in French!

This course turns your cassette player into a "teaching machine." With its unique "pattern drill" learning method, you set your own pace—testing yourself, correcting errors, reinforcing accurate responses.

The FSI's Introductory Basic French Course comes in two parts. Part A provides an introduction to the simpler forms of the language plus a basic vocabulary. Part B introduces more complex structures and additional vocabulary.

You may order one or both parts of the Basic French Course:

☐ Basic French, Part A. 12 cassettes (17 hours) and 200-page text, $115.

☐ Basic French, Part B. 18 cassettes (25½ hours) and 300-page text, $149.

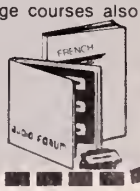
(New York State residents add sales tax)

Your cassettes are shipped to you in handsome library binders.

TO ORDER, JUST CLIP THIS AD and mail it with your name and address and a check or money order. Or, charge to your credit card (American Express, VISA, Master Charge, Diners Club) by enclosing card number, expiration date, and your signature.

The Foreign Service Institute's French course is *unconditionally guaranteed*. Try it for three weeks. If you're not convinced it's *the fastest, easiest, most painless way to learn French*, return it and we'll refund every penny you paid! Order today!

Many other FSI language courses also available. Write us.



Audio-Forum
Dept. M-41
145 East 49th Street
New York, N.Y. 10017
(212) 753-1783

AUDIO-FORUM®

Transparent Solutions

by J. Max Bond, Jr.

THE GLASS HOUSE, by John Hix. *The MIT Press, $9.95 (paperback); 208 pp., illus.*

During the eighteenth and nineteenth centuries, as the needs of plants came to be better understood, systems for heating and ventilating structures used for growing plants evolved rapidly. Concomitantly, plant houses, derived from the "wintering sheds" equipped with braziers to provide a little extra heat for plants grown inside in winter, gradually became more transparent. In the nineteenth century, in particular, the skills required to make glass enclosures developed enormously, to the point that by mid-century the technical skill existed to create such masterpieces as Joseph Paxton's London Crystal Palace (1851), Richard Turner's Palm House at Kew (1845–48), and the Crystal Art Palace in Queen's Park, Glasgow (1873). By 1889, the huge Galerie des Machines, built for the second Paris Universal Exhibition, had been completed.

Their very names suggest the aura that surrounded these tremendously popular structures. The London Crystal Palace was huge, yet it was executed in less than a year—a feat, notes author John Hix in *The Glass House*, of "mass-production, prefabrication, standardization, modular construction, systems-integration ... and ingenuity."

Hix strongly believes that the great technical achievements of the nineteenth-century building industry, which fostered creativity and original solutions to new building problems, can be replicated in our own time, and beyond, in addressing such problems as the reclamation of arid lands, feeding the world's poor, and the energy crisis. Thus, each of the two sections of his book ends with a scheme for the future. The first section, generally about the control of internal climates, concludes with a description of an integrated desert plant house that, while growing vegetables, produces fresh water from salt water. The second section ends with illustrations of a covered arctic city—a finale that reveals quite a bit about the author's purposes and orientation. For despite his obvious appreciation of the beauty of the great glass conservatories, which are amply documented here, Hix's primary concerns are with utility and the solving of problems.

The Glass House focuses on a particular type of glass building: not the church, not the commercial galleria, not the alienating glass tower, but instead the useful (for growing plants), delightful (on a dreary winter day), popular conservatory or exhibition hall favored by the nineteenth-century positivist Western society. The structures featured in the book resulted from increased world trade and the Industrial Revolution. They were created at a time when, as Hix says in his introduction, European society was concerned with "man's growing ability to use the forces of nature." It was a time, too, when technology was still mechanical, visible, and tactile.

The book's themes are developed through both the text and the extensive and fascinating illustrations. One problem with this arrangement, however, is that the text and illustrations often compete for the reader's attention. Still, to some degree, they work together suggestively in that the text is all technology and logic while the buildings shown are often quite sensual in form. At one point, the author tells us that in designing the Crystal Palace, Joseph Paxton developed a floor-cleaning machine that turned out to be unnecessary because the long skirts worn by Victorian ladies swept the floors. As a counterpoint, the pictures convey an image of "properly" dressed and mannered people promenading through an Eden of lush and exotic vegetation.

While the material presented in *The Glass House* is fascinating, the style of its presentation is less than vivid. This seems to stem not only from the conflict between the text and illustrations but also from the organization. The treatment is not chronological: one part of the book deals with environmental-con-



Fern House at Ashridge, by Matthew Digby Wyatt

trol systems and horticulture; another covers the making of the enclosures; and yet other sections describe various types of glass buildings. Consequently, the relationships between people who figured prominently in the unfolding glass drama are difficult to grasp and the cross-fertilization of ideas is difficult to follow. In reading the book, one recalls other works on building, such as *The Great Bridge*, about the construction of the Brooklyn Bridge. That work, although deliberately aimed at a lay audience, also manages to engage the informed reader. Hix's work does not.

There are various subthemes, almost asides, which might have made his effort more compelling had they been developed. Readers learn that at one time the purchase of glass was taxed, and that when the tax was rescinded, glass became much cheaper and, so, more popular. Well, this reader would have liked to know more about this and other aspects of the *context* in which glass buildings evolved. We are told that



RIBA Collection, London

THE WALL CHARTS FOR NATURE LOVERS.

Each print is top quality paper laminated with washable plastic, and includes hangers top and bottom—ready for hanging on your wall. All items are labeled in four or five languages (including Latin), and measurements are included.

ALL PRINTS NOW $6.00 EACH

Because of our product's incredible reception, the continuing strength of United States currency abroad, and our own efficient administration, we are once again able to *reduce* our price. And, if you act immediately, you can

BUY THREE PRINTS OR MORE AND GET ONE SEAFOOD PRINT . . . FREE!

Please add $2.00 shipping and handling charge for initial print, and $.50 for each additional print.

Order your 28" × 40" print(s), by number:

1. North American Fish
2. Fresh Water Fish
3. Sea Fish
4. Game Fish
5. Edible Crustaceans/Shellfish
6. Fish of Southern Seas
7. Fungus (Mushrooms)
8. Garden Birds
9. Sea Birds
10. Butterflies
11. Map of Bright Stars
12. Whales (avail. Dec. 1981)

Shipment within one week from stock in San Francisco. Full satisfaction guaranteed—complete refund if returned, undamaged, within two weeks.

Please send Print No(s): __/__/__/__/__/__

Name _____

Address _____

City/State/Zip _____

Enclosed $ _____ (including $ _____ shipping)

CA residents add 6% sales tax.



FREE COLOR BROCHURE AND CATALOGUE

with any purchase. Included in this year's brochure are prints from Denmark and around the world. The 14 page color catalogue, from the British Museum of Natural History, shows our new line of plant wallcharts.

NATURE LOVERS

380 Peachstone Terr.
P.O. Box 2429
San Rafael, CA 94912

DISCOVERY TOUR TO THE NILE



American Museum of Natural History
Discovery Tours

Discover the world of ancient and modern Egypt on an American Museum 600 mile Nile Cruise. Explore with three lecturers the rich natural and archeological sites of an area which has fascinated visitors for centuries... A carefully planned itinerary (with a special two-day program in London visiting the British Museum with its keeper) provides a relaxing and thorough three-week Discovery Tour. All of the major Nile archeological sites as well as the important wildlife regions are discussed and visited with your balanced team of eminent lecturers. Share with Museum staff and friends an unforgettable cruise. February 9-25, 1982. For further information and itineraries write to the **American Museum of Natural History, Discovery Tours**, Central Park West at 79 St., NY NY 10024, or call (212) 873-1440.



Monuments of Time

The Kawai piano is perfection obtained by the hand of time. Your investment in Kawai enhances with time.

Kawai America Corporation

24200 So. Vermont Ave., Harbor City, Calif. 90710

KAWAI

there was intense competition to secure the commission to build the Crystal Palace; although a few details about the maneuvering that went on are given, we learn nothing about the people involved. Various powerful figures are mentioned, but too little is said about them and their intentions, as in the case of Richard Turner, one of the era's foremost engineers. He constructed the beautiful Palm House at Kew, sometimes competing, and at other times cooperating, with the architect, Decimus Burton. More detailed examination of their interaction could have told us something about the attitudes and dynamics that generated some quite marvelous building designs.

On the other hand, Hix covers a lot of ground in his attention to the development of productive greenhouses, the mastery of climate control, the industrialization of building, the conservation of energy through the use of solar power, and the creativity associated with an orientation toward solving problems through technology. And he addresses a few of the many architectural issues that are germane to the evolution of glass buildings. The private conservatory, he observes, gained popularity, in part, because of changes in the uses of the middle-class house, which had once combined the functions of both home and workplace. As the house became increasingly a place for leisure and entertainment, the conservatory was conceived to enhance those new functions. In 1850, W. Bridges Adam, in describing the criteria that should govern the building of the Crystal Palace, virtually coined what became, a half century later, the slogan of functionalism: "form follows function." (Some of the early glass buildings described in the book are prophetic, foretelling such futuristic designs as Buckminster Fuller's Dymaxion House or James Stirling's marvelous work at Leicester.) Later, the author hints at the current critique of the functionalist position by quoting John Ruskin, who in discussing the Crystal Palace questions whether the solving of technical problems is enough to constitute meaningful architecture. Hix also touches on the dilemma arising out of a technocratic position. While the conservatories and exhibition halls of the nineteenth century were beautiful and were built to promote nature, their ultimate extensions—as expressed in Buckminster Fuller's plan to cover part of New York City with a glass dome and later proposals for plastic-covered arctic cities—suggest, rather, an alienation from nature. We may enjoy visiting the rebuilt Enid D. Haupt Conservatory at

UNIQUE TURNER OFFER



A First Rate taking in Stores
Signed "J M W Turner 1818" (19 x 17 in.)

Superb quality print of a very beautiful Turner watercolour. Art historian B.L. Binyon wrote in 1909 "This is Turner at the peak of his powers, his palette is positively translucent." The original is in a private collection in England, and has rarely been seen since 1819, when it was exhibited at Grosvenor Palace.

A few hundred copies were printed to commemorate Turner's bicentenary. We have every one of them. There will be no more available once these few are gone.

Print $14.90 (Framed $57.59)
Calif. residents add 6% tax. Tel. (213) 452-2443

OXFORD GALLERIES
2210 Wilshire Blvd. #627
Santa Monica, CA 90403

Name_____
Address_____
City_____ State____ Zip____
☐ VISA ☐ M.C. #_____ Exp_____



The Victoria Regia house in Leyden

the New York Botanical Garden, but would we really want to live in a domed New York or under a bubble on the banks of the Mississippi, as Fuller has also proposed? Does it make sense to create a technologically advanced structure just because it can be done or should other principles guide us? The nature of the ground covered lends to Hix's book the character of an illustrated history, a primer on solar energy and the virtues of integrating greenhouses with urban life, and a functionalist's commentary on the evolution of architectural style.

Is it contradictory to say that a book seeks to be too many things, while also saying that the author should have attempted more? I think not—if certain additions would have clarified the format and provided a more solid basis for the reader to assimilate the material, thus enriching the reading experience. Hix's range of concerns is broad, and admirably, he acknowledges the relationship of building as a practical art to economic and social factors, but in the final analysis one wonders whether his strong emphasis on the practical aspects of glass building is not a limitation. This preoccupation perhaps explains his neglect of two of the most significant aspects of glass construction. Yet light is discussed here in regard to its practical qualities rather than its architectural ones—light for warmth and as illumination for the nurturing of plants, not light as an organic and evocative element of architecture. Thus, the Gothic cathedrals, in which light was used to aid in the conjuring of a mystical environment, are not mentioned.



Leyden University Library Collection

Second, the transparency of glass has the effect of integrating man with nature (as exemplified in, say, Mies van der Rohe's Farnsworth House), but this dimension of glass construction receives only passing mention. Moreover, the gridded, abstract exteriors, which the discipline of making a glass skin achieves in its repetition of many relatively small pieces and joints, have led architects to explore minimalist notions about building and form. The short shrift given these aspects of glass construction tends to rob readers of some potentially enlightening discussion.

During the mid- to late-nineteenth century, there were significant developments in several of the artistic disciplines. In painting, the Impressionists were experimenting with light and solidity—the same elements, in a sense, that were commanding the interest of architects in designing the buildings cited by Hix. Certain visual discoveries led to changes in the way the world was perceived, thereby altering the course of modern art and architecture. A discussion of the architecture of light and transparency in *The Glass House* would not only have been in order but would also have been especially rewarding in the context of what was happening in other art media at the time. By merely touching on the potential of glass and its corollary, light, in a rather brief discussion of the Expressionist architecture of the twentieth century, Hix appears to grant the glass building, with its wonderfully intricate space and light interplays, less than its full status in the history of architectural expression.

Had he chosen a larger frame of reference, relating economic, social, personal, and aesthetic issues to his investigation of one building type, Hix might have made of his excellent documentation a more profoundly enlightening work.

J. Max Bond, Jr., is a partner in the firm of Bond Ryder Associates, chairman of the Division of Architecture at the Graduate School of Architecture and Planning of Columbia University, and a member of the New York City Planning Commission.

Share the Thrills of Exploring Outer Space!



$359.95 f.o.b. Hartford, Conn.
$15 Crating Charge

Now it's easy to join the thousands of serious amateurs who have discovered the excitement of exploring our mysterious universe. Your enjoyment begins right from the start, yet the challenges and rewards go on for years! And it's a hobby that can be shared at modest cost.

Choose From Many DYNASCOPES®

Picking a telescope to fit your needs and your pocketbook is simple when you select a DYNASCOPE—the same instruments used by more than 150 schools, colleges and observatories—and your satisfaction is guaranteed by a full-refund warranty.

FASCINATING GUIDE YOURS FREE!

Read these valuable facts before buying any telescope. Mail coupon or postcard for your complimentary copy of this helpful guide.



Criterion Manufacturing Co.
620 Oakwood Ave., W. Hartford, Conn. 06110

® TM Registered U.S. Pat. Office

CRITERION MANUFACTURING CO., Dept. NH 108
620 Oakwood Avenue, W. Hartford, Conn. 06110
Please send your free Telescope Guide.
Name_____
Address_____
City_____ State_____



Breathtaking!

More than 500 of the most magnificent wildlife photographs ever seen—all in full-color—illustrate the renowned animal-film maker's account of his recent experiences in the world's last wildernesses. 150,000 miles of travel in every continent, accompanied by internationally famous photographers, have resulted in a truly thrilling book. Giant size: 9¾ x 13½, 416 pages. $29.95

At your bookstore or from
FRANKLIN WATTS, INC.
730 Fifth Avenue
New York, NY 10019

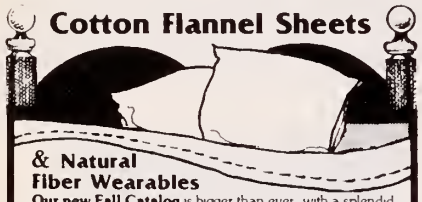
INDIA
&
AROUND THE WORLD with Nepal-Sri Lanka-Bhutan Burma-Thailand

Journeyworld offers you the architectural splendors and unforgettable sights of some of the world's most creative civilisations. You will see the Taj Mahal, Kathmandu in the Himalayas, the stupendous rock carved temples of Ajanta & Ellora, Bhutan a fairy tale Buddhist kingdom, colorful Kandy in Sri Lanka, the glory of Pagan and Mandalay the elephant camps and tribal villages of Chieng Mai.
The programs include comprehensive sightseeing, deluxe hotels and all meals.

For information call or write:

JOURNEYWORLD
155 East 55th St., New York, N.Y. 10022
Tel (212) 752-8308

Cotton Flannel Sheets



& Natural Fiber Wearables
Our new Fall Catalog is bigger than ever, with a splendid collection of beautifully fashioned natural fiber sleepwear and clothing. Our **Cotton Flannel Sheets** offer the widest size selection, greatest color variety and lowest prices for the **quality** available anywhere.
We're the **source** for natural **energy-saving wearables** like pure wool, cotton or silk underwear for men and women—we can outfit you from head to toe in **quality** natural fibers for day or night. **For children**: a wide range of natural fiber clothing, crib bumpers, quilts and sheets.
Send $1 for color catalog with swatches to:

garnet hILL
661A Main St., Franconia, N.H. 03580
Visit our shop in Franconia! Open Mon.-Sat.

Crossroads of Evolution
Galapagos
Cruise Darwin's "enchanted island" by private yacht. Photograph unusual wildlife. Enjoy stimulating lectures by naturalist/guides. Visit artistic Cuenca on mainland Ecuador. 15 days. Write for details.

Society Expeditions
Dept. NH-10
723 Broadway East,
Seattle, WA 98102

Name
Street
City/State/Zip

Please include: ☐ New Guinea ☐ Galapagos ☐ Mongolia ☐ Tunisia ☐ Antarctica ☐ Amazon ☐ New Guinea & Melanesia ☐ New Guinea & Indonesia ☐ Singapore to Seychelles ☐ Arabia ☐ Iceland & Greenland ☐ N. & West Africa ☐ China

The Science—and Art—of Keeping Warm

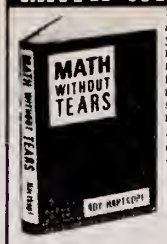
Historical Perspective

Some books dealing with the relationship of climate to design are: R. Banham's *The Architecture of the Well-tempered Environment* (Chicago: University of Chicago Press, 1969); J.M. Fitch's *American Building* (Boston: Houghton Mifflin, 1972); B. Givoni's *Man, Climate and Architecture* (Amsterdam: Elsevier, 1969); and V. Olgyay's *Design with Climate* (Princeton: Princeton University Press, 1963). W. Hough's *Fire as an Agent in Human Culture* (Washington, D.C.: Smithsonian Institution, Bulletin No. 139, 1926) is a fundamental work on the making, conservation, and application of fire in nonindustrialized populations. K.P. Oakley wrote several important articles on the prehistory of fire, including "Possible Origins of the Use of Fire" (*Man*, 1961, p. 207) and "Fire as a Palaeolithic Tool and Weapon" (*Proceedings of the Prehistory Society*, vol. 21, pp. 36–47).

People

In his sensitively written *Japanese Homes and Their Surroundings* (New York: Dover Books, 1961), E.S. Morse describes the structural and cultural aspects of the Japanese home at a time when Japan had experienced little Westernization. See also T. Yoshida's *The Japanese House and Garden* (New York: Praeger, 1955) and B. Rudofsky's *The Kimono Mind* (Garden City: Doubleday, 1965). S. Shōnagon served as a lady-in-waiting at the royal court during the last decade of the tenth century. Her vast collection of notes detailing her life during this time forms *The Pillow Book of Sei Shōnagon*, translated and edited by I. Morris (New York: Columbia University Press, 1967, two volumes), a rich source of information about traditional Japanese upper-class life. The earliest accounts of the Eskimos, their houses, clothing, tools, and weapons are by G. Best and D. Settle. Works by these authors are reprinted in V. Stefansson's two-volume *The Three Voyages of Martin Frobisher* (London: Argonaut Press, 1938). Stefansson wrote in great detail about the Eskimos' adaptation to cold, most notably in *The Friendly Arctic* (New York: Macmillan, 1921), *My Life With the Eskimo* (New York: Macmillan, 1913, reprinted in paperback by Collier Books, New York, in 1962), and *The Fat of the Land* (New York: Macmillan, 1956). *The Central Eskimo*, by F. Boas, published in 1888 and reprinted in paperback by the University of Nebraska Press, Lincoln, in 1964, is a classic and comprehensive account of Eskimo life during the 1880s. A more modern account of one of the most isolated Eskimo groups, containing precise information about Eskimo technology, is A. Balikci's *The Netsilik Eskimo* (Garden City: Natural History Press, 1970). A recent, excellent summary of Eskimo prehistory, dealing also with Eskimo prehistory in Alaska and Greenland, although only briefly, is R. McGhee's *Canadian Arctic Prehistory* (Ottawa: National Museum of Man, 1978). Cold, its effects upon humans, and how humans have tried to cope with it are the subjects of L. Kevaler's very readable *Freezing Point* (New York: John Day Co., 1970). Similarly specialized is R. Kirk's *Snow*, an easy to read, well-researched book with an excellent and extensive bibliography that deals in detail with the Eskimos' use and knowledge of snow as an insulating material. For a scholarly treatment of the Eskimos' physiological and cultural adaptations to the rigors of their homeland, see E.F. Morani's *Human Adaptability*

MATH WITHOUT TEARS



Using non-technical language and a light touch Roy Hartkopf gives you a basic understanding of many everyday applications of mathematics. He takes the reader from simple counting to trigonometry and calculus, emphasizing the practical aspects of math. Humorously written.
Learn math in the comfort of your own home at minimum cost.

Order Now $10.95 plus $1.10 hdlg
EMERSON BOOKS, INC.
Dept 917-F Buchanan, N.Y.
10511
10 Day Money Back Guarantee

For the eleventh year we invite fourteen discerning travelers who are interested in ecology, wildlife and photography to join our leisurely yacht cruises to

Discover Galapagos®

AUGUST 13 TO 25 and OCTOBER 22 TO NOVEMBER 3, 1982

We provide a full week at these unique islands, with ample time for daily shore expeditions under expert guidance, and before the cruise we enjoy three days in Quito, Ecuador's lovely capital, with excursions in the Andes and then make the spectacular road journey to the coast

Detailed brochures of the cruises and a copy of our newsletter which lists all our fascinating travel programs available from

HANNS EBENSTEN TRAVEL, INC
705 WASHINGTON STREET, NEW YORK, NY 10014
TELEPHONE (212) 691 7429

WHEN YOU WRITE TO NATURAL HISTORY

about a change of address, renewal of subscription, billing, or any kind of adjustment, send the present address label from the magazine wrapper.

Moving? Please notify 6 weeks in advance. You can use this form to tell us about a move or order a subscription.

Change of address—Attach your address label in the dotted area and fill in your new address below, clip and mail to Natural History Membership Services, P.O. Box 4300, Bergenfield, N.J. 07621.

Cut your old address label from magazine wrapper and attach over this area.
Fill in your NEW address and mail to:
Natural History Magazine
Membership Services P.O. Box 4300
Bergenfield, N.J. 07621

PLEASE PRINT

Name _____

New Address _____

City _____ State _____ Zip _____

(North Scituate: Duxbury Press, 1979). Two books by F. Bruemmer are *The Arctic* (New York: Quadrangle/The New York Times Book Co., 1973), which covers the adaptation to cold by arctic plants, animals, and northern people, and *Seasons of the Eskimo* (New York: New York Graphic Society, 1971), which records the seasonal cycle of Eskimo life and cultural adaptations to the severe climate.

Animals

S.C. Kendeigh's "Energy of Birds Conserved by Roosting in Cavities" (*Wilson Bulletin*, vol. 73, pp. 140–47) discusses how birds use this strategy to save energy and maintain higher temperatures during periods of extreme weather. Articles on energy-saving techniques of black-capped chickadees include B. Kessel's "Winter Activity Patterns of Black-capped Chickadee" (*Wilson Bulletin*, vol. 88, pp. 36–61) and S.B. Chaplin's "Daily Energetics of the Black-capped Chickadee" (*Journal of Comparative Physiology*, vol. 89, pp. 321–30). L. Irving's *Arctic Life of Birds and Mammals, Including Man* (New York: Springer-Verlag, 1972) includes chapters on arctic environment, land birds and their migration, maintenance of arctic bird populations, and warm temperatures of birds and mammals. In "Physiology of Hibernating Bears," G.E. Folk, A. Larson, and M.A. Folk consider whether the term *hibernation* is justified, and review all the conspicuous papers on the subject (*Bears: Their Biology and Management*, edited by M.R. Pelton, J.W. Lentfer, and G.E. Folk. New York: Unipub, New Series Publications no. 40, 1976). R.A. Nelson reviews the physiological and metabolic processes involved in hibernation in "Winter Sleep in the Black Bear" (Rochester: Mayo Clinic Proceedings 48, pp. 733–37). L. Rogers summarizes in six nontechnical pages his knowledge of bears, including how they relate to people, denning, and cub behavior, in "The Ubiquitous Black Bear" (*North American Big Game*, edited by W.H. Nesbitt and J.S. Parker. Washington, D.C.: The Boone and Crockett Club and the National Rifle Association of America, 1977). B. Ford's *Black Bear: Spirit of Wilderness* (Boston: Houghton Mifflin, 1981) is a scholarly, up-to-date general book with a good section on hibernation. P.D. Watts et al. propose a new definition of hibernation in "Mammalian Hibernation and the Oxygen Consumption of a Denning Black Bear" (*Comparative Biochemistry and Physi-*

Have More Fun With
HANDGUIDE TO THE CORAL REEF FISHES



. . . the most comprehensive, beautifully illustrated and accurate guide available for snorklers, divers and fish hobbyists. Shows 460 species in full color, along with 50 different corals, invertebrates and plants. For the beginner as well as the advanced student. Has easily-understood descriptions, useful hints on fishwatching, and unique checklists for quick identification.

4½x7½" hard cover, 160 pages.
$9.95 includes postage and handling.
Send your check today to
The Academy of Natural Sciences
Att: Publications — Handguide
19th and Parkway, Philadelphia PA 19103
PA residents add 60¢/copy sales tax.



Order Today

PLESIOSAURUS 19" by 7½"

All Three $19.95



BRONTOSAURUS 21" by 6½"



Perfect Christmas Presents

STEGOSAURUS 17" by 9"

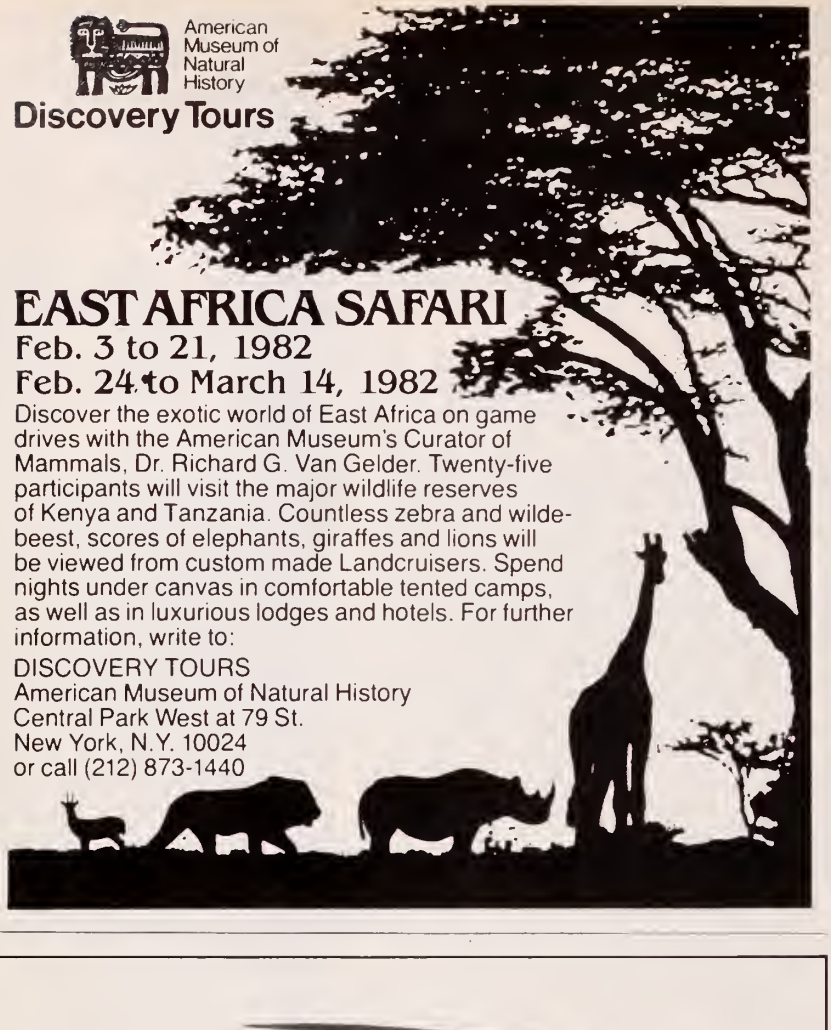
PREHISTORIC MUSEUM

Great fun. Educational. Quality laminated woods, precision die-cut for easy assembly. Money back if not satisfied. Each set $19.95 plus $3.70 postage/handling. Send check or charge VISA/M-C. Calif. delivery add $1.42 tax.

Chasers Chasers Inc., P.O. Box 2210 Del Mar, California 92014

☐ VISA #
☐ M-C
Signature
(Please Print) Expiration Date
Name
Address
City ST. Zip

American Museum of Natural History
Discovery Tours



EAST AFRICA SAFARI
Feb. 3 to 21, 1982
Feb. 24 to March 14, 1982
Discover the exotic world of East Africa on game drives with the American Museum's Curator of Mammals, Dr. Richard G. Van Gelder. Twenty-five participants will visit the major wildlife reserves of Kenya and Tanzania. Countless zebra and wildebeest, scores of elephants, giraffes and lions will be viewed from custom made Landcruisers. Spend nights under canvas in comfortable tented camps, as well as in luxurious lodges and hotels. For further information, write to:
DISCOVERY TOURS
American Museum of Natural History
Central Park West at 79 St.
New York, N.Y. 10024
or call (212) 873-1440

SEMINARS IN ORNITHOLOGY
The Laboratory of Ornithology at Cornell University Offers a Home Study Course in Bird Biology
Inquire: NH, 159 Sapsucker Woods Road, Ithaca, NY 14850

ology Journal, vol. 64, pp. 121–23).

Plants

Coevolution of Animals and Plants, edited by L.E. Gilbert and P.H. Raven (Austin: University of Texas Press, 1975), is a collection of ten papers, emphasizing the importance of coevolution as a dynamic process. The volume attempts to cover, as broadly as possible, all of the ways plants interact with animals. D.M. Gates's "The Energy Environment in Which We Live" (*American Scientist*, vol. 51, pp. 327–58) describes the radiant heat loads of plants and animals and the mechanisms for dissipating a heat load, and analyzes the energy budget and its diurnal temperature cycle. P.K. Kevan's "Sun-tracking Solar Furnaces in High Arctic Flowers" (*Science*, vol. 189, pp. 723–26) explains how the flowers of two common High Arctic plants, which occur widely in arctic and alpine regions, maximize their small heat budgets by sun tracking and how insects that bask in them also gain heat. *Arctic and Alpine Environments*, a 999-page text edited by J.D. Ives and R.G. Barry (London: Methuen, 1974), provides a comprehensive summary of our present knowledge of alpine and arctic environments and identifies the gaps in our understanding. On a more popular level is *The Mountains*, edited by L.J. Milne and M. Milne (New York: Time Inc., 1962), which has an informative text and many color photographs, but contains some factual errors. Treatises on specific ecosystems discussed in this issue include: *An Arctic Ecosystem: The Coastal Tundra at Barrow, Alaska*, edited by J. Brown et al. (Stroudsburg: Dowden, Hutchinson and Ross, 1980); *Truelove Lowland, Devon Island, Canada: A High Arctic Ecosystem*, edited by L.C. Bliss (Edmonton: University of Alberta Press, 1977); *Geoecology of the Colorado Front Range: A Study of Alpine and Subalpine Environments*, edited by J.D. Ives (Boulder: Westview Press, 1980). See also K. Scherman's *Spring on an Arctic Island* (Boston: Little, Brown and Co., 1956), her popular account of her expedition to an island north of the Arctic Circle.

Clothing

A. C. Guyton's *Textbook of Medical Physiology* (Philadelphia: W.B. Saunders Co., 1976) is a standard reference that gives some information on the physiological problems experienced at high altitudes. For more information on clothing designed to protect from the cold, see L.H. Newburgh's classic

Physiology of Heat Regulation and the Science of Clothing (Philadelphia: W.B. Saunders Co., 1949), a technical but readable treatise. *Materials and Clothing in Health and Disease*, by E.T. Renbourn (London: H.K. Lewis and Co., 1972), treats a wide range of subjects from the anatomy and physiology of clothing to its history, psychology, and function. E.E. Stout's illustrated *Introduction to Textiles* (New York: John Wiley and Sons, 1970), often used as a college text, explains differences between various materials. The last chapter of L. Irving's *Arctic Life of Birds and Mammals, Including Man* (New York: Springer-Verlag, 1972) covers the historical use of clothing, the early shelters and clothing of the Eskimos, and adjustments to cold by urban dwellers and by natives of cold climates.

Housing

Insulation Manual: Homes and Apartments is designed to provide home builders, architects, and engineers with a complete source of reliable information on the proper use of insulation, its economics and benefits. To obtain a copy, send $10 to the National Association of Home Builders Research Foundation, P.O. Box 1627, Rockville, Md., 20850. *Energy Primer: Solar, Water, Wind and Biofuels* is available from the Portola Group, Menlo Park, California. A basic, nontechnical explanation of solar energy with a comprehensive bibliography, F. Daniel's *Direct Use of the Sun's Energy* (Westminster: Ballantine Books, 1964) has been reprinted several times. For additional construction and performance details concerning the heating devices described in "House Warming," send $4.00 in money order to cover costs of reproduction, postage, and handling to Great Plains Apiaries, Rt. 2, Box 137, Purcell, Oklahoma 73080. *Oldtown Folks*, by H.B. Stowe, edited by H.F. May (Cambridge: The Belknap Press of Harvard University Press, 1966), follows the text of the first edition published in 1869 and recaptures local traditions and life in early-nineteenth-century New England. D. Ludlum's *The Country Journal New England Weather Book* (Boston: Houghton Mifflin Co., 1976) contains chapters on various aspects of weather and historical accounts of remarkable weather phenomena with many early illustrations. F. White's "Stoves in Nineteenth-Century New England" (*Antiques*, September 1979, pp. 592–99) describes in detail the types of stoves introduced in the 1820s and 1830s. Two of the most important references on indoor air pollution are "Comparison of Indoor and Outdoor Quality" by D.J. Moschandreas et al. (Palo Alto: The Electric Research Tower Institute, March 1981, EI 1733), and E.T. Brookman's "Exposure to Pollutants From Domestic Combustion Sources: A Preliminary Assessment" (Research Triangle Park: EPA, 1980, no. 600/7-80-084). Other references include "Indoor Air Pollution in the Residential Environment," by D.J. Moschandreas et al. (Research Triangle Park: EPA, December 1978, no. 600/7-78-229); "Study of Indoor Air Quality," by W.A. Cote et al. (Research Triangle Park: EPA, 1974); "Carbon Monoxide Levels in Kitchens and Homes With Gas Cookers," by T.D. Sterling and A. Sterling (*Journal of the Air Pollution Control Association*, vol. 29, pp. 238–41); and "Cigarette Smoke in Closed Spaces," by V.R. Hoegge (*Environmental Health Perspectives*, vol. 2, pp. 117–28).

Rita Campon

Thank Goodness for Flannel Sheets!
I Thought I'd "Freeze to Death"



When I went to England, I just knew it was going to be the trip of a lifetime. I had saved and planned for years. Then, out of the blue, I got a chance to spend a few days in an honest-to-goodness 13th Century castle on Ilkley Moor while I was in Yorkshire.

What I overlooked was the English idea of central heating. After I left London the weather suddenly turned shivering cold and wet. By the time I got to Denton Hall I was too tired and miserable to care about picturesque charm and history. All I could think of was how uncomfortable I was going to be in an old, drafty castle.

Sure enough, my room was *freezing*. But when I crawled into bed I was dumbfounded to discover how marvelously cozy it was despite the lack of heat.

There was a big, puffy down comforter on top. Underneath, the sheets and even the pillowcases were flannel. And not that flimsy, pilled kind we used to have at summer camp. They were luxuriously soft, thick real *English cotton flannel*.

I felt utterly pampered in plushy comfort. And I never slept better, because I wasn't buried under layers of heavy bedclothes.

Then and there I decided I was going to have sheets like that at home. What a great way to save on heating costs at night and still feel rich and special!

When I got back to the United States I soon learned that the flannel sheets in stores didn't feel or look the same at all. The polyester in them made such a difference.

Finally, I got so frustrated I went to Damart, a company in my home town, and suggested they sell real English flannel sheets and pillowcases. They loved the idea.

And that's how Agatha's Cozy Corner was born. We talked it over and added heavenly down comforters and some other things as well as the sheets. And now I'd be happy to send you my catalog. It's printed in color, and gives you the pictures and story of everything we sell. Just use the coupon for your free copy.



© 1981, Agatha's Cozy Corner



AGATHA'S COZY CORNER
DEPT. NH101
Woodbury Plaza
Portsmouth, N.H. 03801

Yes! I would like to receive a FREE copy of Agatha's Cozy Corner Catalog. Please send it right away.

PRINT NAME

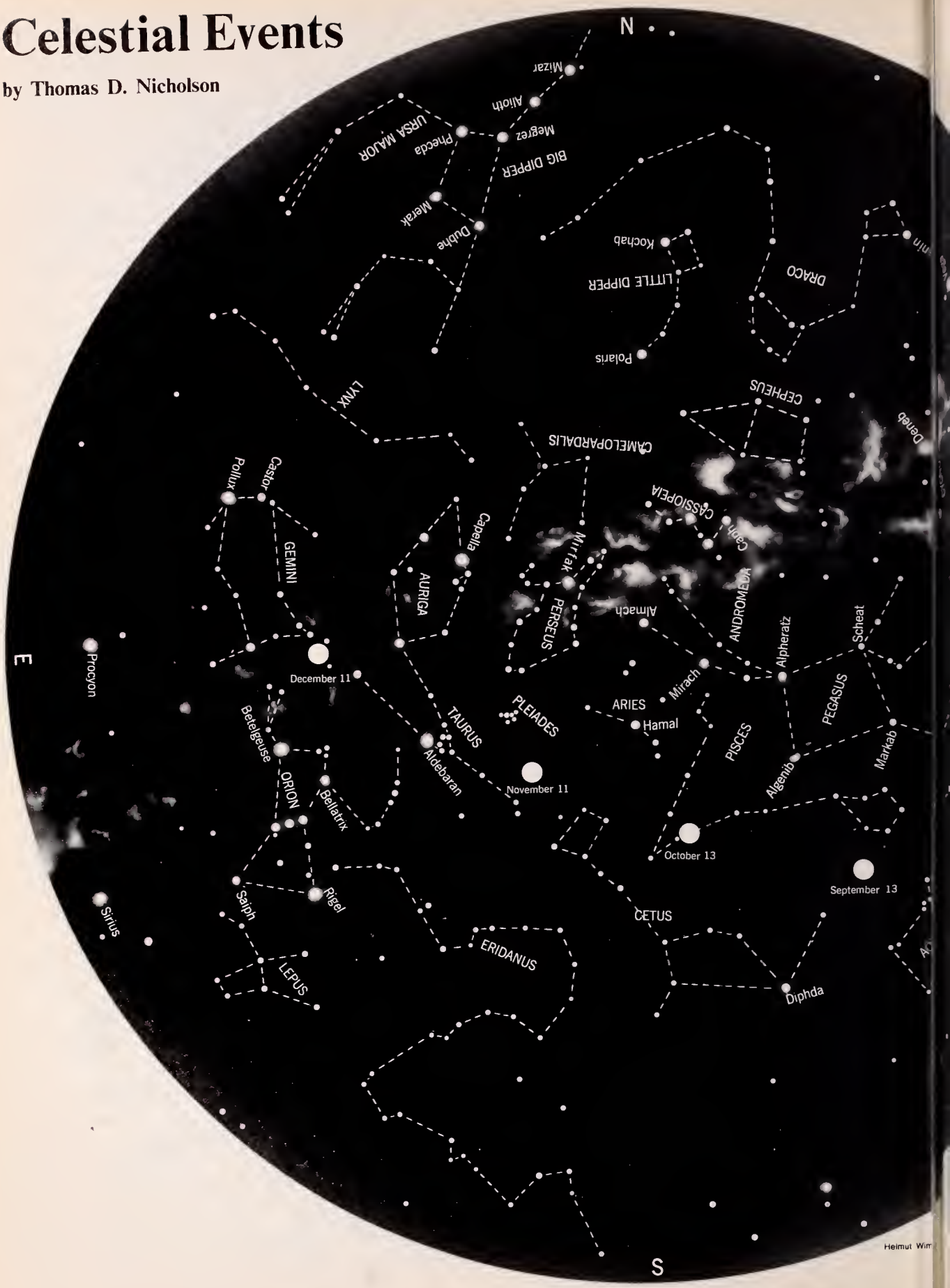
Address

City

State Zip

Celestial Events

by Thomas D. Nicholson





Moon October begins with an evening moon, a slim waxing crescent in the west just after sundown. It passes above Venus on the 1st, above Scorpius on the 3rd, and through Sagittarius (look for the eight stars of the "teapot") on the 4th and 5th. First-quarter moon is on October 6, full moon (in Aries, but well to the left of the vernal equinox) on the 13th, last-quarter (just below the twin stars of Gemini) on the 19th, and new moon on the 27th. In November, first-quarter is on the 4th, full moon (with perigee and spring tides) on the 11th.

Stars and Planets We had a sky full of evening stars in September, but the evening sky falls apart in October when Mercury, Jupiter, Saturn, and Pluto shift into the morning sky. The sole planet seen in the evening sky this month is Venus, and that is only because it is bright enough to stand out in the early twilight after sundown. Look in the west from about half an hour after sunset until just before dark. This isn't a good evening visit for Venus, however. The morning sky isn't much better. Only Mars is in good position, well up in the southeast by daybreak, but rather dim. Fortunately, it can be recognized near Regulus, the bright star of Leo, which it joins as a "twin" star late in the month. Even though they shift from the evening to the morning sky, the planets are still gathered in or near the constellation Virgo. The sun remains in Virgo all month (moving into Libra for November), along with Mercury, Jupiter, Saturn, and Pluto. Venus, Uranus, and Neptune are just east of Virgo. Venus is in Libra, but moves into Scorpius and then Ophiuchus. Uranus is in Libra and Neptune is in Ophiuchus; while Mars remains in Leo all month, just west of Virgo.

October 1: The moon passes well above brilliant Venus.

October 5: Saturn, in conjunction with the sun, enters the morning sky.

October 6: Mercury is stationary, poised for its retrograde (westerly) motion through the stars.

October 11: Look for the Square of Pegasus (four stars arranged in a box) above the gibbous moon. The moon is just below the vernal equinox (also called the First Point of Aries), but won't be in Aries until the 13th.

October 13: This is the night of the hunter's moon, the full moon of October, which appears full or nearly full and rises at or shortly after sunset for the next three nights.

October 14: Jupiter's turn to enter the morning sky comes today when it is in conjunction with the sun.

October 18: Mercury becomes a morning star today when it passes between the earth and the sun (inferior conjunction).

October 19: Mars has been moving east toward Regulus, in Leo. Today it passes above the star. Look in the southeast before dawn for the two objects.

October 21: The Orionid meteor shower reaches maximum this morning, at its best from 2:00 A.M. on. The shower is not particularly productive (about 25 meteors per hour), but some very bright meteors result from this swift stream, believed to be associated with Halley's comet.

October 22: The waning crescent moon passes Regulus and Mars and is visible in the morning sky.

October 25: Daylight time ends at 2:00 A.M.

October 26: Mercury resumes direct (easterly) motion.

October 31: The crescent moon passes Venus in the evening sky.

November 2: Mercury, at greatest distance east of the sun, is in good position in the morning sky. Look before sunrise below the star Arcturus.

November 5: There is a good chance to see Mercury today, just above Jupiter, rising in the east before the sun.

November 10: Venus is at greatest easterly elongation, but this is not a good evening configuration for the planet.

The autumn Star Map shows the sky from the mid-latitudes (40° N) of the Northern Hemisphere during the evening hours given below. To use the map, hold it in front of you vertically with the letter N at the bottom, and match the *lower* half of the map with the stars you see when you face north. As you face in other directions, turn the map to bring the corresponding compass direction to the *bottom* of the map when facing you. The stars move west continuously throughout the night. By morning (before dawn) stars on the western half of the map will have set, those on the eastern half will have moved into the west, and new stars (those of the spring evenings) will have risen in the east.

The map represents the sky at about 2:00 A.M. on October 1; 1:00 A.M. on October 15; midnight on October 31; 11:00 P.M. on November 15; 10:00 P.M. on November 30; 9:00 P.M. on December 15; and 8:00 P.M. on December 31. Add one hour for daylight time. The map can be used for an hour or more before and after the times given.

Brain Puzzler's Delight

By E. R. Emmet



A treasury of unique mind-stretching puzzles that can be solved by straight, logical thinking and reasoning. No specialized math. Offers the pleasures of discovering solutions through use of ingenuity, imagination, insight, and logic. Stimulates and refreshes the mind. Fascinating, entertaining puzzles, arranged in order of difficulty, with (some amazing!) solutions and full explanations at end of book. ILLUSTRATED. $9.95 plus $1.25 handling. 10-Day Money-Back Guar.

EMERSON BOOKS, Inc., Dept. 918-F
Buchanan, N.Y. 10511

Wildlife Adventures

- Whale Watching in Mexico
- Polar Bear Photography
- Tanzania Wildlife Safari
- Gorilla Viewing in Congo

Many other trips

Travel in small groups with the experts

For 81-82 Preview & itineraries contact

Adventures International
4421-AS Albert St.
Oakland, CA. 94619 (415) 531-6564

Free Samples

Boost Your Vocabulary

Get your free samples of Capt. Ergo's™ Famously-Funny™ Word-power Cards
800-243-7857 (In CT 938-9533) Ext. K-33

Print Name _____
Address _____
City _____ State _____ Zip _____
Tele. No. (___ ___) _____ Age _____

CAI The College Achievement Institute
Dept K-33 Redding Ridge, CT 06876
Member Direct Mail-Marketing Ass'n

UNIVERSITY MUSEUM TOURS
UNIVERSITY OF PENNSYLVANIA

COME WITH US INTO THE PAST

Find your roots in the company of a small compatible group and the archaeologists who are unearthing them.

China, October '81 (sold out); **Thailand-Burma,** January '82 ____ **Egypt,** February '82 ____; **Yucatan,** March '82 ____; **Sicily,** May '82 ____; **Alaska,** July, '82 ____; **China,** October '82 ____

For detailed information check tour interest and mail to:
Museum Tours (Dept. _B_) University Museum, 33rd & Spruce Sts., Phila., PA 19104. Or phone (215) 243-4023.

The Margaret Mead Film Festival

The fifth annual Margaret Mead Film Festival will be held at the American Museum on Saturday and Sunday, October 17 and 18. More than forty films will be presented. Many are premières, including David and Judith MacDougall's *A Wife Among Wives*; Robin Lehman's *Little Players*; Allen Moore and Jack Shea's *The Shepherds of Berneray*; *Village of No River*, by Stuart Hersch; and many others.

Films will be shown from 11:00 A.M. to 5:00 P.M. in five areas of the Museum: the Auditorium, the People Center, Gallery 77, the Education Hall, and the Hall of Mexico and Central America. Admission to all programs is free.

A new film about Margaret Mead herself opens the Festival at 11:00 A.M. on Saturday, October 17, in the Auditorium. *Margaret Mead: Taking Note* was produced for the television series "Odyssey," and focuses on various aspects of her life—her personality, anthropological work, and social activism. She is shown in the field, at the American Museum, and at a national women's convention. There are excerpts from her own films and interviews with people who knew her well—her daughter, her first husband, and some of her colleagues.

Films screened in the Auditorium on Saturday focus on "Disappearing Ways of Life." One of these films documents one year in the life of *The Shepherds of Berneray*, a tiny island in the Outer Hebrides of Scotland. The island's young people are abandoning their rugged existence as shepherds and fisher-



From the Stilt Dancers of Long Bow Village, *by Richard Gordon and Carma Hint*

men for a different kind of future on the mainland, and in time, Berneray will be deserted, and its Gaelic culture, now kept alive only by the old people, will disappear.

Sunday at 11:00 A.M. in the Auditorium, David and Judith MacDougall's film, *A Wife Among Wives*, will be premièred. The third and final part of their acclaimed trilogy on the Turkana, a seminomadic herding people in northwestern Kenya, this film is a sensitive portrayal of the Turkana women's view of polygamous marriage.

Sunday afternoon four films on "Black Heritage" will be shown in the Auditorium, including *Tapdancin'*, a beautifully photographed documentary about tap-dancing in America. This film traces the history of the art, paying





THE MUSEUM SHOP

For your holiday gift giving, remember the Museum Shop. You can visit us or mail this coupon for a new fall catalog.

American Museum of Natural History
Museum Shop Catalog, Department NH
CPW at 79th St.
New York, N.Y. 10024

Name
Address
City
State Zip



Treasures From The Earth

Color Portfolio of Natural Specimens and Catalog of Minerals, Display Stands, Books and Natural Jewelry, $3.00

Dover Scientific
Box 6011C Long Island City, NY 11106

For the ninth year we offer intrepid travelers the world's most challenging and rewarding tourist experience

Greenland Dog-sledging Expeditions

MARCH 27 TO APRIL 13, 1982

Two weeks are spent on Greenland's breathtaking West Coast under the expert guidance of a leading Arctic explorer. Travel is by helicopter and husky-drawn sledges.

Detailed brochures of this expedition and a copy of our newsletter which lists all our fascinating travel programs available from

HANNS EBENSTEN TRAVEL, INC
705 WASHINGTON STREET, NEW YORK, NY 10014
TELEPHONE (212) 691-7429

ELECTRONIC BARGAINS

3-MELODY QUARTZ ALARM CLOCK
$19.95 ea.



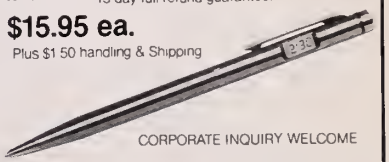
Plus $1.50 handling & Shipping.

• Displays hours; minutes, month & date • Alarm indicator • Quartz control for accuracy • Night light • Pull-out stand • Unique slide-out bracket for car or desk use • Batteries included • Snooze alarm mode • 2-5/8"x1-3/8"x3/8" • Perfect gift for the traveler • Black case with brush metal face

LCD DIGITAL WATCH PEN

LCD Quartz • Displays hours, minutes, seconds, date and month • Battery included • Takes parker size refill • Slim design - only 9mm thick • Silver-tone finish 15 day full-refund guarantee.

$15.95 ea.
Plus $1.50 handling & Shipping



CORPORATE INQUIRY WELCOME

CALL TOLL FREE
1-800-257-7850 Op. 653
NEW JERSEY 1-800-322-8650 Op. 653
NEW YORK RESIDENTS ADD SALES TAX
M.C., Visa Cards accepted. Please give card No. & Exp. date or send check or M.O. to

COLUMN ONE MARKETING, INC.
21-03 41st Ave.
Long Island City, N.Y. 11101 N

particular attention to the problems faced by black performers. It includes interviews with tap-dancers, a tour of a modern studio, and segments of virtuoso performances, some from early films.

Programs in the People Center will be about "Polar Peoples" on Saturday and "Archeology" on Sunday. Gallery 77 features "Portraits" on Saturday and films about "Social Issues" on Sunday. Films in the Education Hall will focus on "Spiritual Worlds" on Saturday, and "China" on Sunday. *The Living Maya*, in four one-hour segments, will be shown both days in the Hall of Mexico and Central America. Made by anthropologist Hubert Smith, *The Living Maya* is the Festival's only video production.

Margaret Mead was an educator and a humanist as well as a scientist. She felt strongly that anthropology, the study of humankind, should be understood by all people, not just by professionals; that people should learn about other ways of life so they could better comprehend their own; and that vanishing cultures should be recorded on film. Although she was a skillful and prolific writer, she thought that some of the best anthropological studies had been made with the camera and that film was perhaps the most direct and effective way to portray a people. In 1977, two years before her death, she fulfilled a long-standing wish by establishing the first Margaret Mead Film Festival. Now the Museum is continuing this tradition.

For more information and a complete schedule of the 1981 Margaret Mead Film Festival, write to the Department of Education, American Museum of Natural History, Central Park West at 79th Street, New York, NY 10024 or call (212) 873-1070.

Douglas J. Preston

Art of the Rain Forest

A major exhibition, *African Arts of the Suriname Rain Forest*, will open on Wednesday, October 28, in Gallery 3. Made up of 359 objects from the daily life of the Maroons, the exhibition shows how artistic expression is one of the fundamental elements of what has been called the most African of all Afro-American cultures.

The ancestors of the present-day Maroons were African plantation slaves who, during the late seventeenth and eighteenth centuries, escaped into remote regions of northeastern South America and established independent societies that are still flourishing today.

Maroon art has been previously thought by scholars to consist almost exclusively of woodcarving, and this exhibition will introduce for the first time a number of arts virtually unknown outside of Maroon villages, including textiles, basketry, jewelry, and a large number of calabash bowls. The exhibition will be open through January 24, 1982.

Seventeenth-Century Suriname Insects

An unusual exhibit in the Library Gallery is devoted to the work of Maria Sibylla Merian (1647-1717). In the late 1600s, Merian, the daughter of a Swiss engraver, gave up her life in Europe and voyaged to Suriname, where she painted watercolors of insects and flora. On display will be seventeenth- and eighteenth-century folios with hand-colored engravings of her work and fine reproductions of her watercolors, many of which were bought by Catherine the Great of Russia and remain in that country. The exhibit will open October 1.

Fall Lecture Series

Museum scientists and other well-known authorities will give courses in a variety of subjects including anthropology, archeology, art, and the natural sciences. Each course consists of three to eight programs of lectures, films, slides, or laboratory instruction. This is a fine opportunity for adults of an inquiring turn of mind to learn more about any of the seventeen topics offered, including Asian dancing, Tibetan culture, American archeology, and alternatives to sociobiology. The lecture series opens the third week in October, and prices range from $20 to $85. Contact the Department of Education at (212) 873-7507 for details and registration materials.

The Politics of Creation

Fundamental creationism, thought to have become obsolete with the Scopes "monkey trial," seems to have had a resurgence. Quotes by eminent scientists and scientific theories have been misconstrued to support the position of the group known as scientific creationists.

On Wednesday, October 28, at 7:30 P.M., noted scientist and *Natural History* columnist Stephen Jay Gould will present a slide-illustrated lecture exploring the current theories of evolution within the scientific community. He will then focus on how the creationists are distorting scientific principles to achieve their own ends.

Tickets for the lecture will be $2.00 for members, $4.00 for nonmembers. For ticket availability please call (212) 873-1327.

The Parade of Life

David Attenborough, who has recently completed the filming of a thirteen-part series "Life on Earth" (to be shown early next year on PBS) will present a special preview at the Museum on Sunday, October 25, at noon and 3:00 P.M. Using excerpts from the series, he will tell of his adventures during the filming in such places as the Comoro Islands, the Galápagos, and the Great Barrier Reef. The series traces the evolution of life from the first one-celled inhabitants of the primordial oceans through the more complex forms to *Homo sapiens*. The lecture will be free for members and $2.00 for nonmembers. For ticket availability please call (212) 873-1327.

Workshops for Young People

The Department of Education is offering five stimulating weekend courses for children this fall: "Photographing New York," "Exploring with the Microscope," "The World of Dinosaurs," "Reptiles and Amphibians," and "Human Origins." All will be taught by recognized scientists and educators and are specially geared for children of grades 4 through 7. The workshops start the weekend of October 24; tuition is from $14 to $20. Call the Department of Education at (212) 873-7507 for more information.

Planetarium Sky Shows

"Night of the Hunter," an exploration of the constellation Orion, will be shown through November 23. "Stars of the Season," an introduction to astronomy and the fall sky, will be shown Wednesdays at 7:30 P.M., and, beginning October 3, Saturdays at 11:00 A.M. The show covers several exciting topics, including the changing seasons, meteors, and the constellations and bright planets that will be visible this autumn. For schedules and prices, call the Hayden Planetarium at (212) 873-8828.

Laserium

The Hayden Planetarium will be featuring two Laserium programs: "Light Years," which combines laser art with songs from twenty-five years of rock-and-roll, and "Rock Alive," which uses the music of seventeen modern groups, including Led Zeppelin, Deep Purple, and Yes. The Laserium shows will run on Wednesday, Friday, Saturday, and Sunday evenings. Call the Planetarium at (212) 724-8700 for more information and admission prices.

Guided Tours

The Museum offers free tours, led by Museum volunteers, to give visitors an inside glimpse of the history of the Museum and to provide an introduction to its vast collections. Visitors may join the "Museum Highlights Tour" at the second floor Information Desk. Inquire at the desk on the day of your visit for specific times.

Give a GIFT of NATURAL HISTORY

Give one at $15 and save 20% on subsequent gifts at $12 each

This Christmas, one of America's favorite pro[illegible] ng and intelligent people, and a wonderful way to share the pleasures of the Museum of Natural History to someone special. easy to order. Just send this postage-paid form This exciting gift is appreciated by discriminat- with your order today.

☐ YES, send _____ gifts, which include 12 thought-provoking issues of Natural History and all the benefits of a one-year Associate Membership in the American Museum of Natural History. (Save 20% on all additional gifts)

J517

GIFT FROM:

Name _____

Address _____

City _____

State _____ Zip _____

☐ 1 Gift a $15 _____ $15

☐ Additional Gifts at $12 _____
(20% savings)

Total Enclosed $ _____

☐ Payment enclosed ☐ Bill me

Charge my ☐ Visa ☐ Mastercharge
☐ American Express

Account number

Signature _____

Outside U S A please add $4 postage

GIFT TO:

Name _____

Address _____

City _____

State _____ Zip _____

Gift card to read

GIFT TO:

Name _____

Address _____

City _____

State _____ Zip _____

Gift card to read

Moneyback guarantee if not satisfied



NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO 30 NEW YORK N Y

POSTAGE WILL BE PAID BY ADDRESSEE

Natural History
P.O. Box 4200
Bergenfield, N.J. 07621

AMERICAN MUSEUM OF NATURAL HISTORY
Vacations on sea and land with Museum Lecturers



NILE CRUISE: Explore the astounding ancient sites and natural wonders of Egypt with a Museum geologist, ornithologist illustrator, and Egyptologist. Cruise 600 miles on the Nile from Cairo to Assuan aboard the custom-built, air-conditioned *Nile Star* stopping at all the important sites which have intrigued visitors since their construction.

INDONESIAN ODYSSEY: Cruise through the paradise islands of Bali, Java, Komodo, Sulawesi, Lombok, Flores, Butung, the Moluccas and Luciparas aboard the luxury vessel, *Regina Maris*. Share with a Museum astronomer, anthropologist, ornithologist, geologist/volcanologist, and herpetologist a unique, in-depth travel experience. The itinerary takes you to lush tropical landscapes with exotic peoples influenced for centuries by India, Islam and Europe.

GALAPAGOS ISLANDS CRUISE: Discover a special natural world with fantastically tame and exotic animals such as sea lions, giant tortoises, marine and land iguanas and countless rare and beautiful birds. Enjoy the expertise of a Museum ornithologist and herpetologist and four local naturalists as we cruise through this equatorial archipelago which so influenced Darwin.

ADRIATIC AND AEGEAN ADVENTURE: Relive the great historical travels of the Greeks, Romans, Phoenicians and Venetians. Follow their paths on a classical cruise starting in Venice and going to Dubrovnik, Corfu, Corinth, Crete, Rhodes, Tunis, Carthage, Malta, Sicily, Pompeii, Herculaneum and Naples. The *Orpheus* will be your home for 14 beautiful days; the Museum faculty will be outstanding.

LAND PROGRAMS: Seven outstanding overland itineraries have been custom-designed for small groups of 15-25 participants. Famous and remote sites and cultures are discovered while staying at the finest accommodations available with expert Museum Lecturers.

DESTINATION	1982 Dates
☐ Archeology Tour to Mexico	January 11 to 29
☐ Ancient Maya Archeology	February 1 to 18
☐ East African Safaris	February 3 to 21
	February 24 to March 14
☐ Nile Cruise	February 8 to 28
☐ Indonesian Odyssey	February 21 to March 13
☐ Art and Archeology Tours to China	March 23 to April 15
	April 7 to May 3
	September 16 to October 13
☐ Anthropology Tour to Morocco	April 4 to 17
☐ Galapagos Islands Cruise	June 9 to 21
☐ Alaskan Wildlife Adventure	June 25 to July 12
☐ Adriatic and Aegean Adventure	September 1 to 16

Please send me information regarding the itineraries of the tours I have checked.

Name _____ (Please print)

Address _____

City _____ State _____ Zip _____

American Museum of Natural History

Discovery Tours

Central Park West at 79th Street New York, N.Y. 10024
(212) 873-1440

THE MARKET

Art

AMERICAN INDIAN CRAFTS: Storytellers; Pueblo pottery (Red Starr, Nampeyo, Frogwoman, etc.). Hopi 2nd and 3rd Mesa plaques. Kachinas. Old and new rugs. No catalogue. One-of-a-kind pieces, individually photographed. Most priced $100/up. Write for photos and data, specifying interests. Box 5896, Sherman Oaks, CA 91413 (213) 789-2559

BEAUTIFUL CIBACHROME PRINTS: numbered and signed by the artist, illustrated literature. G. Anthony, 2030 Duck Lake Rd., Whitehall, MI 49461



Pre-Columbian Rubbings of Ancient Temple Ruins

DIVING GOD (Mayan 564 A.D.) at Tulum, the walled-city of the Yucatan overlooking the Caribbean—only one of many splendid rubbings! Complete catalog $2 (deductible with order)

BERNARDO
2400 Westheimer 108W (NH10)
Houston, TX 77098

FOR THE WILDLIFE ENTHUSIAST a new high quality color lithograph 13⅝ x 19 of nesting Wood Ducks. Limited edition, signed and numbered. Free brochure. Albert Joransen, 4209 78th Ave. N., Brooklyn Park, MN 55443

FREE! COLOR BROCHURE, Large National Park Prints by M. Woodbridge Williams. Photo Classics, Dickerson, Maryland 20753

HAND CARVED Iroquois Spoonmouth False Face, $90, request photo, McCoy Imports, Liberty, NY 12754

MAKE YOUR OWN unique statement with distinctive notecards. Rocky Mountain nature scenes, hand-drawn pen and ink sketches on extremely fine quality paper, matching envelopes. $5.00 for samples refundable with order. The Lion's Eye Graphics, Box 562, Grand Lake, Colorado 80447

NOW YOU CAN own world-famous poster-art! Lithographic reproductions. Write: Posters, Box 573-N, Hicksville, NY 11802

SHADOW PUPPET POSTERS from the Javanese shadow play. Full size (20X26) strikingly beautiful black on white reproductions. $10. Shadow Graphics, Putney, Vermont 05346

Astronomy

ASTRONOMY MADE CLEAR. Beginners and kids love this telescope—great views, ultra-simple. Astrocan, $209.95. The clearest star-finder, easy and elegant: The Bowl of Night, $62.95. Pocket Sundial $12.95. Nocturnal $7.95. Colorful cardboard kits: Sundial $3.95, Armillary $4.95, Sextant $8.95, Astrolabe $11.95. Telescopes, slide sets, star atlases, books. Straight talk on astro-stuff. Everything in the Universe, 17N Thorpe St., Somerville, MA 02143 (617) 666-4697

Book Publishers

PUBLISH YOUR BOOK! Join our successful authors. Publicity, advertising, beautiful books. All subjects invited. Send for fact-filled booklet and free manuscript report. Carlton Press, Dept. NHJ, 84 Fifth Avenue, New York 10011

Books

PUBLISHERS' OVERSTOCKS, BARGAIN BOOKS. 2,000 titles, all subjects! Free catalogue. Hamilton's, 98-55 Clapboard, Danbury, CT 06810

"THE LITTLE STRIKER" by Russell Moore, tells the story of Tara, a Least Tern, and her struggle for survival within the environment of the Cape Cod National Seashore. A poignant, sensitive novel written with a perceptive insight. Lower Cape Publishing, Box 901, Orleans, MA 02653 $6.00 ppd

"TROPICA"—Cyclopedia of Exotic Plants, 7,000 color photos, 1,136 pages, $115. Request circular. Roehrs, Box 125, E. Rutherford, NJ 07073

YESTERDAY'S BOOKS LOCATED, no obligation. Out-of-State Book Service, Box 3253J, San Clemente, CA 92672 (714) 492-2976

Collector's Items

BIRDS, ANIMALS OR FLOWERS on postage stamps from many countries. 25 different 35¢. George Ford, P.O. Box 5203-N, Gulfport, FL 33737

RECEIVE VALUABLE MINERALS MONTHLY! Free Details! Write today! Mineral of the Month Club, 13057-H26 California, Yucaipa, CA 92399

Correspondence

MAKE FRIENDS WORLDWIDE through international correspondence. Illustrated brochure free! Hermes-Verlag, Box 110660/NH, D-1000 Berlin 11, West Germany

ORIENTAL WOMEN SEEK CORRESPONDENCE for cultural exchange, language practice, friendship. Asian Exchange, Honokaa, Hawaii 96727

PENFRIENDS-ENGLAND-USA. Make lasting friendships through correspondence. Send age, interests. Free reply. Harmony, Box 89NH, Brooklyn, NY 11235

Education

ANTIOCH/NEW ENGLAND GRADUATE PROGRAMS: Combines coursework and internship; individualized approach. Master of Science in Teaching/Environmental Studies: Coursework includes: ecological theory, environmental science, field ecology, (ornithology, geology, botany), political economy of environmental issues, environmental education philosophy, etc. Teacher Certification available. Master of Science in Resource Management: interdisciplinary work in Environmental Science, Organization and Management. Prepares individuals for leadership of organizations involved in management of environmental resources. Further information contact: Antioch/New England, Box NH, Keene, NH 03431

EXPLORE MICROSCOPIC WORLD—algae, protozoans, blood cells, etc. New Science Course for all ages. How to purchase and use a microscope with free brochure. Life Sciences, Box 591C, Woodbury, NJ 08096

Employment Opportunities

AUSTRALIA NEEDS YOU! Jobs! Paid Transportation! Newest handbook, $2.00 (guaranteed). Australian International Services, Box 19107-RX, Washington, DC 20036

AUSTRALIA—NEW ZEALAND! 50,000 Jobs! Big pay. Free transportation. Employer listings $2.00. Austco, Box 772-NH, Cypress, CA 90630

OVERSEAS—ALL OCCUPATIONS! Worldwide Directory and complete information—$3.00. International Opportunities, Box 19107-RX, Washington, DC 20036

OVERSEAS JOBS—68 COUNTRIES! Hiring now! Paid fare. Computerized reports $2.00. Jobworld, Box 681-NH, Cypress, CA 90630

Energy Conservation

SAVE ENERGY. Cut Electric Bills. Complete Windmill Manufacturer's List $3.00. GNHI, Box 115, Orleans, MA 02653

Foreign Newspapers

WORLDWIDE ENGLISH NEWSPAPERS. 65 countries including Kenya. Sampler: 5/$2.98. Free Brochure. Multinewspapers, Box DE-200, Dana Point, CA 92629

Gourmet Interests

ALL NATURAL BREAD easy recipe, whole wheat and yeast. Nutritious. Also Quick Easy Elegant main course and dessert. $2.50. Sofie, P.O. Box 2001, New Canaan, CT 06840

CRUSTLESS QUICHE—Nutritional delight. Easy recipe. $1 and SASE. Paula, 3080 Seaview Lane, Bellmore, NY 11710

FANTASTIC SOUPS! Palate pleasing. Home Kitchen Tested. 5 gourmet Easy recipes. Hot and cold. $2.00 SASE. CC, 10113 Joershke Dr., Suite 193, Grass Valley, CA 95945

FREE... CATALOGUE OF TEAS AND POTPOURRIS deliciously aromatic and flavorful. Sensibly priced. Send today! Emporium 2, P.O. Box 187, Fair Haven, NJ 07701

HEARTY CHEESE SOUP AND SPINACH CASSEROLE. These delicious recipes are protein and vitamin packed. $1 and SASE. Peacock, 18370 Yauger Rd., Mt. Vernon, Ohio 43050

MAKE SUMPTUOUS HOLIDAY GIFT with old world style Fruitcake recipe. SASE and $2 to Foster Fruitcake, Box 463, Troy, Idaho 83871

MARMALADES, Grapefruit, Lemon and Orange. Easy recipes $4.00. Send Chriscookery, Box 571, Huntington Station, NY 11746

OLD OUEBEC STYLE Chili Con Carne. Send $2 SASE to Box 194, Mountlake Terrace, WA 98043

PIZZA Recipe. Send $3 for secrets and recipe to Pizza, P.O. Box 450, Medina, WA 98039

Government Surplus

"GOVERNMENT SURPLUS DIRECTORY." Buy 500,000 items (including Jeeps) ... low as 2¢ on dollar! Most complete information available-$2.00. Disposal, Box 19107-RX, Washington, DC 20036

JEEPS—$58.00!—CARS—$35.00!—700,000 Items! Government Surplus—Most Comprehensive Directory Available. Tells How, Where To Buy—Your Area—$2—Moneyback Guarantee—"Surplus Information Services," Box 99249-DC10, San Francisco, California 94109

Health

TOBACCO SMOKE ANNOY YOU? For list of materials to help you assert your right to breathe clean air, SASE. The Gutenberg Press, 1932 McGee, Berkeley, CA 94703

Merchandise/Gifts

BRIDGECLOTH SETS 54" square with 6 napkins. White with hand appliqued flowers. Specify green, yellow, pink, blue. $39.95 ppd. Money Back Guarantee. Check, Visa, Master-charge. CC, 10113 Joerschke Dr., Suite 193, Grass Valley, CA 95945

EDELWEISS PLANT of nostalgia and romance, perennial for garden or pot $15, seeds $10, flower $5, dry arrangement $25 ppd. Szarotka, P.O. Box 366, Portland, OR 97207

FREE CATALOGUE—Peoplefeeders and birdfeeders. Wildlife prints, Austrian backscrubbers, Norwegian footwear dryers, more. Quality merchandise, gifts and decor items. Fresh ideas from The Armchair Emporium Ltd., 825 Surrey Ln., Dept. NH, Algonquin, IL 60102

HANDWOVEN WOOL RUGS in lightfast plant colors and natural fleece yarns. $6.00 square foot. Color brochure: Harvest of the Spirit, 803 S. Hall, Grangeville, ID 83530

NEW COLLECTION! Magnificent song birds, shore birds, waterfowl, game birds. Master Chinese artists meticulously hand-carved and painted these detailed sculptures of fine-grained wood. Send $1.00 for beautiful color catalogue. By Bobbie Imports, Dept. NH10, 997 LaPaz Road, Santa Barbara, CA 93108

NOTECARDS FROM WATERCOLORS of California Spring Wildflowers California Poppy, Rhododendron, Wild Strawberry, Douglas Iris, Shooting Star. 15 cards and envelopes. Satisfaction guaranteed $10.50. Fairlee Ltd., P.O. Box 1223-A, Healdsburg, CA 95448

PURCHASE Bowie, Civil War knives, Indian tomahawks. Robert Abels, 2881 N.E. 33 Court, Fort Lauderdale, FL 33306

Music

RECORDS-TAPES! Discounts to 73%. All labels, no purchase obligations, newsletter, discount dividend certificates. 100% guarantees. Free details. Discount Music Club, 650 Main street, P.O. Box 2000, Dept. 25-1081, New Rochelle, NY 10801

Old Time Radio

OLD TIME RADIO PROGRAMS on cassette tapes. Free catalogue. Cassette Library Center, P.O. Box 5331H, Baltimore, MD 21209

Optical

BINOCULAR SALES AND SERVICE. Repairing binoculars since 1923. Alignment performed on our U.S. Navy collimator. Free catalogue and our article "Know Your Binoculars," published in Audubon Magazine. Mirakel Optical Co., Inc., 331 Madison St., West Coxsackie, NY 12192 (518) 731-2610

LEITZ, ZEISS, B&L, SWIFT, BUSHNELL, NIKON. Optolyth binoculars, telescopes and accessories. Send stamp for discount list. Specify literature desired. Large stock. Orders filled postpaid day received. Birding, Box 5N, Amsterdam, NY 12010

OPTIC DISCOUNTS: Binoculars—Telescopes—Brand Names—Free List. Thos. Manetta, Box 12, 61 Hoffman Avenue, Elmont, NY 11003

Periodicals

OFFSHOOTS OF ORGONOMY. A semi-annual, layman's magazine on using atmospheric life energy in horticulture, art, education, child-rearing, birthing, etc., based on Wilhelm Reich's discoveries. $5.50/issue. $10/year. P.O. Box 1248, Gracie Station, New York, NY 10028

Photography

AMATEUR PHOTOGRAPHERS: Your photographs can be better! End frustration—make your photography rewarding and fun. Working New York professional gives you individual help. Write Guy Gillette, 133 Mountaindale Road, Yonkers, NY 10710

THE FLYING EAGLE®. Finest laser color reproductions of the ultimate Bald Eagle photograph. 16 x 20 Fine Art Print, $20. Kenneth R. Hunter, Ph.D., Egegik, Alaska 99579

WOLF PHOTOS, slides, postcards. Free brochure, lists. J. Lidle, P.O. Box 112, Clifton Heights, PA 19018

Real Estate

FREE! Big Fall-Holiday Catalogue! Over 5,400 country properties described, pictured! Land, Farms, Homes, Businesses, Waterfront, Recreation, Retirement buys! Selected best thruout the U.S. Over 700 offices, 43 states. All Across America! Yours Free from the World's Largest! Strout Realty, Inc., 60 E. 42nd Street, Dept. 5390, New York, NY 10017

FREE . . . 296-PAGE CATALOGUE. Describes and pictures over 2,800 farms, ranches, acreages, businesses and town and country homes from coast to coast. United Farm Agency, Inc., 612-V W. 47th St., Kansas City, MO 64112. Ph. Toll-Free: 1-800-821-2599, MO. Res. Ph. Toll-Free: 1-800-892-5785

GOVERNMENT LANDS . . . FROM $7.50/ACRE! Homesites, farming, vacationing, investment! "Land Buyer's Guide" plus nationwide listings—$2.00. Lands, Box 19107-RX, Washington, DC 20036

Resorts

FAR OFF THE BEATEN TRACK . . . Very small, very special hotel tucked into a 30 acre plantation on the island of Bequia, St. Vincent Grenadines, W.I. 10 rooms, fresh water pool, beautiful beach, snorkeling, hiking, photography, birding, tennis. Write or call Spring on Bequia, Box 19251, Minneapolis, MN 55419, (612) 823-1202, or your travel agent. Member of Distinguished Inns and Historic Hotels

LITTLE ST. SIMONS ISLAND

One of Georgia's "Golden Isles"



Birding, beachcombing, riding, wildlife photography, fishing or just relaxing on a secluded 12,000 acre island with miles of unspoiled ocean beaches, forests and marshes. Over 200 species of birds. Maximum of 10-15 guests at a time. Excellent food and accommodations. Professional naturalists on the staff. **Little St. Simons Island** P.O. Box 1096N, St. Simons Island, GA 31522

TOBAGO, PRIVATE BEACH COTTAGES on working cocoa plantation. Swimming, snorkeling, fishing from your front door. Bird watcher's paradise. Brochure. Charles A. Turpin, Charlotteville, Tobago, West Indies

VACATION/RELAXATION—Birdwatcher's delight—Peaceful, secluded nature lover's mountain retreat. Cave Creek Ranch, Portal, Arizona 85632

Tours/Trips

ADVENTURES—Photograph polar bears in the Arctic during October, touch a whale in the breeding lagoons during February, sail among humpback whales in Hawaii. Trips specializing in natural history with expert leaders to Tanzania, Kenya, Botswana, Rwanda and Zaire. Also Australia, Nepal, Sri Lanka, Ecuador and more. Unique expeditions to see endangered species—mountain gorillas, blue whales, Indian rhino and rare birds. New 1981-1982 trip preview available. Adventures International, 4421-N. Albert St., Oakland, CA 94619

AFRICA. KENYA & TANZANIA. Top quality wildlife safaris. Winter and summer departures. Also: Galapagos Islands, Ecuador, Peru, Patagonia, the Amazon and Nepal. Very small groups. Expert naturalist leaders. For free illustrated catalogue, write: Wilderness Travel, 1760-CA Solano Ave., Berkeley, CA 94707 (415) 524-5111

AMAZONAS ADVENTURES: Explorer's Inn (Peru). Amazon Lodge (Brazil). Orellana (Ecuador). Chapare (Bolivia). Day/overnight jungle expeditions/cruises. Combinable with 155 other South America programs. Forum International, 2437 Durant, Berkeley, CA 94704 (415) 843-8294

BIRDING CALIFORNIA, Baja and west coast Mexico with Dr. Dennis Paulson. Washington wildflowers. X-C British Columbia. Alaska and Hawaii. Brad's Tours, 401 E. Mercer 31D, Seattle, WA 98102

CARNIVAL IN BRAZIL. Attend Bahia's extraordinary, African-influenced pre-Carnival festivities + 7 days sailing Brazil's magnificent coast. Unique anthropological adventure. Write: Wilderness Travel, 1760-CB Solano Ave., Berkeley, CA 94707

COSTA RICA NATURE TOUR. Comprehensive, naturalist-led tour of this fascinating, tropical land. December, 1981. Write: Wilderness Travel, 1760-CN Solano Ave., Berkeley, CA 94707

DISCOVER BAJA! Join professional naturalists & crew for ocean going exploration of Baja's wilderness islands and lagoons. Gray whales up close, elephant seals, superb birding & lots more! Excellent photo opportunities, small groups. Color brochure. Pacific Adventures Charter Service, 2445 Morena Blvd., Suite 200H, San Diego, CA 92110

ECONOMIC GALAPAGOS. Weekly departures. Seven or fourteen nights in Galapagos with optional Ecuador, Amazon, Peru. University credit available, non-students welcome. Dr. R. Lainhart, Biology Dept., Towson State University, Towson, MD 21204 (301) 321-2443 or 922-3116

EXPERIENCE THE COASTAL MARINE Environment of Northeast Baja. 7 days $365. California Dive/Sail, P.O. Box 6645, San Diego, CA 92106 (714) 222-9329

FASCINATING NATURE/LEGENDARY CULTURES: Usual and unusual travel programs to Latin America, Africa, Mideast. Features Machu-Picchu overnights, Amazon, Galapagos, Madagascar, etc. Groups/Individuals. Reasonably priced. Forum International, 2437 Durant, Berkeley, CA 94704 (415) 843-8294

5,000 YEARS PERUVIAN TEXTILE ART: visit museums, markets, weavers, and archaeological sites. Skilled leadership and weaving instruction. Forum International, 2437 Durant, Berkeley, CA 94704 (415) 843-8294

GALAPAGOS HIKING AND SAILING EXPEDITIONS. Small groups. 1982 dates: February 4, April 22, July 7, August 4. Charters. Machu-Picchu options and Chili ski options. Inca Floats, 5982N Balboa, Oakland, CA 94611 (415) 339-9095

HIMALAYAN TRAVEL, INC. Trekking expeditions in the Everest and Annapurna areas of Nepal. Exotic cultures/spectacular mountain scenery. Box 481-NH, Greenwich, CT 06830. Toll Free (800) 243-5330

INDIA/NEPAL WILDLIFE SAFARI. Outstanding game observation in three major reserves + Delhi, Taj, Kathmandu, Himalayas. $1375.00. Also, comprehensive program of trekking expeditions in Nepal's Everest & Annapurna regions from $895.00. Airfares additional. Free brochure. Himalayan Travel, Inc., Box 481-NH, Greenwich, CT 06830. Toll Free (800) 243-5330

NEW ZEALAND NATURAL HISTORY. Trek and River Expedition, January and February 1982. Polynesian Island Trek & Tahiti Arts Workshop, December 1981. Write James Henry River Journeys, P.O. Box 807-M, Bolinas, CA 94924 (415) 525-6578

NEW ZEALAND WALKABOUT: A selection of escorted nature and hiking tours, featuring New Zealand's scenic National Parks, the Milford Track, Farm Holiday Stay. Pacific Exploration Company, Box 3042-N, Santa Barbara, California 93105

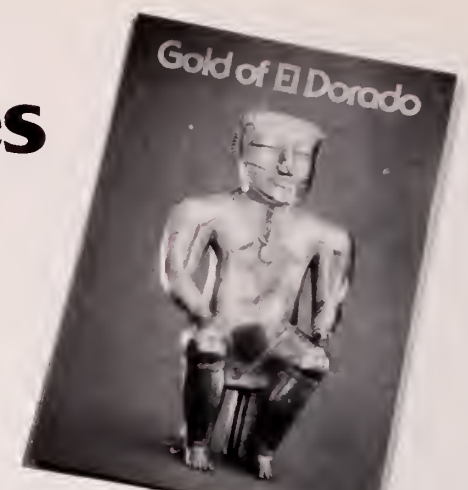
SAVE 50% ON CRUISES. Our members do. You can too. Details free. TravLtips Association, Box 188B5, Flushing, NY 11358

SCOTTISH HIGHLANDS. Wildlife trips weekly April-October. Other wildlife destinations include Shetland, Orkney, Iceland, Tanzania, Canary Islands, Nepal, Texas, Arizona & California, and Alaska. Also backpacking and trekking in Nepal, Peru, Bhutan and Scottish Highlands. Expert leadership. Write McGregor Travel, 33 Lewis Street, Greenwich, Connecticut 06830, or call: (800) 243-5330

VISIT THE GALAPAGOS ISLANDS LEISURELY, designing your own expedition with the De Roy family's 33 ft. sailboat. Capacity 4 passengers, multi-lingual naturalist. For information write: Gil De Roy, Isla Santa Cruz, Galapagos, Ecuador

ADIRONDACK WILDERNESS SKI TOURS: Enjoy the exhilaration and beauty of a northern winter in the company of expert naturalist guides. Cross-country ski vacations are five days, limited to 12 guests. Day trips into "forever wild" Adirondack Forest Preserve. Explore habitats of deer, beaver, bobcat, coyote, bear, fox, otter, pine marten, fisher, mink. Evenings spent in cozy backcountry lodge enjoying hearty homecooked meals, good company, and fireside programs with noted ecologists, historians, photographers, and conservationists. Write: Adirondack Ski Tours, McMaster Rd., Saranac Lake, NY 12983. Or call: (212) 546-9202

An Art Book That Took Centuries To Create



It took the American Museum of Natural History four years to arrange its exceptional exhibition of more than 500 pieces of ancient gold from Colombia. But those few years are a brief time when compared with the decades archeologists have spent digging (literally!) and studying the gold artifacts from tombs, caves, and buried sites. And all that time is short when compared with the many centuries prehistoric Indians practiced their craftsmanship and artistry to create these treasures.

So when it became the United States sponsor for this outstanding collection, the American Museum faced a dilemma. Could we do justice to all this effort and scholarship and beauty? We think we have. First, by dramatically displaying *Gold of El Dorado: The Heritage of Colombia* in one of our largest halls. The glowing reports from visitors tell us our efforts have been worthwhile. If you don't have a chance to see the show for yourself in New York, we hope you will see it in Chicago, San Francisco, or New Orleans on its year and a half tour.

The second challenge for the American Museum was the creation of an appropriate book to accompany the exhibition. We decided against a traditional catalog; against a small, boring volume with tiny black-and-white pictures that could never do justice to these fine objects. Instead, we decided to present a select number of the finest pieces of pre-Columbian gold in a large, stunning format. And to represent the three important elements that make a great art book we chose outstanding professionals.

First, photographer Lee Boltin. One of the greatest photographers of art objects, he also took the famous pictures of the Tutankhamun show. We sent him abroad to find and record great pieces of pre-Columbian art.

Second, archeologist Warwick Bray, from the University of London. One of the world's foremost authorities on pre-Columbian art, Bray is also a skilled writer, able to present fascinating background in a succinct, readable essay in the book. Dr. Bray organized the Colombian gold exhibition in London.

Third, Harry N. Abrams, Inc., America's leading publisher of fine art books. In a co-publishing venture with the American Museum, Abrams designed the book, supervised the preparation of 30 large color plates, and monitored the fine-quality printing.

The result is an unprecedented exhibition book. It is bold and big—each plate is 16 by 11½ inches—bigger than this magazine *opened up*. The paper is heavier than most posters. In fact, many persons have purchased two copies of the book in order to have one set of these fine art prints for framing.

And now for the happy ending. Because the Museum is a co-publisher, we are able to offer this soft-bound art book at a major savings from its normal retail price of $12.50. We are pleased to offer *Gold of El Dorado* to subscribers for only $6.25—a 50% savings off its regular price. This special offer is valid only during the exhibition and only while our limited supply lasts. We suggest that you order one or more copies immediately. Of course, if you are not satisfied after you have had an opportunity to examine it in your home, simply return the book and the Museum will refund the purchase price.

Natural History Books

Gold of El Dorado Book
American Museum of Natural History
77 West 77th Street
New York, N.Y. 10024

YES, I want to purchase _____ copy/copies of the Gold of El Dorado book. I ☐ enclose payment of/☐ authorize you to charge me $6.25 per copy (plus $1.00 for shipping and handling).

My name _____

My address _____

City _____ State _____ Zip _____

For charge orders only:

Charge to: ☐ Master Charge ☐ VISA ☐ American Express ☐ Diners Club

Interbank # (Master Charge Only) _____

Account # (All digits) _____

Expiration Date _____

Signature _____
(required if using credit card)

Order

_____ book(s) @ $6.25 $ ____

Shipping and handling $1.00

N.Y. Sales Tax (if applicable) ____

TOTAL $ ____

(Make checks payable to American Museum of Natural History)

Sunbelt Cuisine

Southern cooking is this country's major surviving native cuisine

by Raymond Sokolov

Millions of practical, footloose Americans have solved the problem of keeping warm in an era of zooming fuel costs by taking the path of least resistance. They have headed south where, much of the time, naturally available solar energy warms their bones and heats their homes at no cost at all. This migration has enormously distorted American life, undermining the political strength of the depleted Northeast, straining the water resources of the Southwest, and generally shaking up established patterns everywhere. One harmless benefit the "new carpetbaggers" have acquired in their flight from chill is daily access to Sunbelt food, that amalgam of traditional Deep South and western cooking that is this country's major (and perhaps only) surviving native cuisine.

For the past two years, I have been poking about all over the United States searching for healthy vestiges of regional cooking and regional foods. Almost everywhere I have gone, the dishes and ingredients touted with pride in cookbooks or at chamber of commerce events have all but vanished from the normal life of the area or are seriously threatened by industrially produced foods from other places. Agribusiness and the homogenization of modern life have turned people everywhere away from pristine clambakes, wild persimmons, and other once-rife local delicacies and on to the foreshortened national menu of hamburgers and other fast foods. But in the Sunbelt states, they order things better.

Southern-fried chicken and barbecue are in no sense vanishing foods. Indeed, as everyone knows, they have spread to the four corners of America. The mystique of good ol' boy chow has captivated folks in Boston and San Francisco. As early as 1972, fast chicken emporiums had reached Manhattan and soul food was available in many white neighborhoods. This trend has not slowed in the ensuing decade. First Kentucky, then Kansas fried chicken appeared around New York City. (More recently, perhaps as a kind of chauvinist backlash, someone opened a "New York" fried chicken restaurant.) And within the last year, fast chicken purists in the Big Apple finally got a chance to sample the southland's spiciest, crispest mass-produced fried chicken when Popeye's came to town.

With such authentic Sunbelt fare now available in my own city, you might think I would not bother to travel to Atlanta for southern cooking. Even without Popeye's practically in my backyard, I could easily have satisfied my craving for finger-licking fare by cooking one of the many outstanding fried chicken recipes I have managed to salt away (see below). As it happens, I went to Atlanta last May to meet with publishing friends at the American Booksellers Association's annual convention and, well aware of the wave of murders terrorizing the city, I resolved to take my meals in my hotel.

One look at the dismal dining room there, however, and old reflexes asserted themselves. I took to the street in search of an authentic southern breakfast and found it at a large, peaceful downtown cafeteria.

What drew me inside the S & W, a branch of a chain that extends throughout the Southeast, was a perplexing item on the menu in the window: "battered country bacon, 45 cents." This was a regional specialty I had never heard of. Did they beat crisp bacon until it shattered? It might be interesting.

At the service counter, I was handed a plate with a long, brittle, dark brown strip on it. Suddenly I realized what it was: southern-fried bacon. To the blinkered northern sensibility, this will sound like the ultimate redneck abomination. Batter-fried bacon. Refried fat.

On the palate, however, this down home specialty had its points. The bacon itself was thick-sliced slab bacon, tasty as always. And the crisp coating, which did shatter when cut, complemented the fattiness of the bacon in much the same way that toast goes with bacon in a bacon, lettuce, and tomato sandwich.

Munching on my battered bacon, I sank into speculation on the southern mania for southern frying almost everything. At its best, this method "surprises" the flavor of food and seals it in, while leaving the chicken or catfish moist and fresh inside. Southern cooks, building on these basic recipes, have extended the frying of breaded foods—from hush puppies to crab cakes to fried oysters to southern-fried partridge and quail—further than cooks of any other area.

Perhaps the most extreme form of this propensity is chicken-fried steak, not everybody's idea of refined food, but I did meet a Texan book salesman in Atlanta who visibly salivated at the mention of the dish.

For the restaurateur, deep-frying is an ideal method. Once the fat has been heated to the appropriate temperature, it can be reused several times (obviously this can be overdone and often is). The



Photographs by Adelaide de Menil

Atlanta's famous Municipal Market features row upon row of food stands. Pork, the southern favorite, is prominently displayed. At right is a mound of pork sausage in the shape of a hog's head.

process is quick and ideally suited to modern fast-food situations. You can, moreover, deep-fry almost anything. A friend of mine ran a fryolator at a chicken joint in the Southwest during a high school summer vacation. To relieve the boredom of the job, he took to methodically southern frying old sneakers. They came out golden brown, looking like giant fritters.

Southern cookery, of course, includes much more than just southern-fried foods. Among the ingredients ineradicably associated with Sunbelt eating are a huge menu of cornmeal recipes, from spoon bread to corn bread to corn pones to hush puppies. Corn also figures in the most folkloric and primordial Sunbelt recipe of all: grits.

Grits are actually hominy—corn leached out of the kernel with a lye solution. The Indians did the same thing with ashes and water. The resultant hominy, when boiled, turns into the white, porridgy starch always present at real Sunbelt breakfasts. Almost every northerner I know turns his nose up at grits. I think the name has a lot to do with it. If, for instance, the same cornmeal mush were served under its Italian title, polenta, it would sit better than it does as plain old grits.

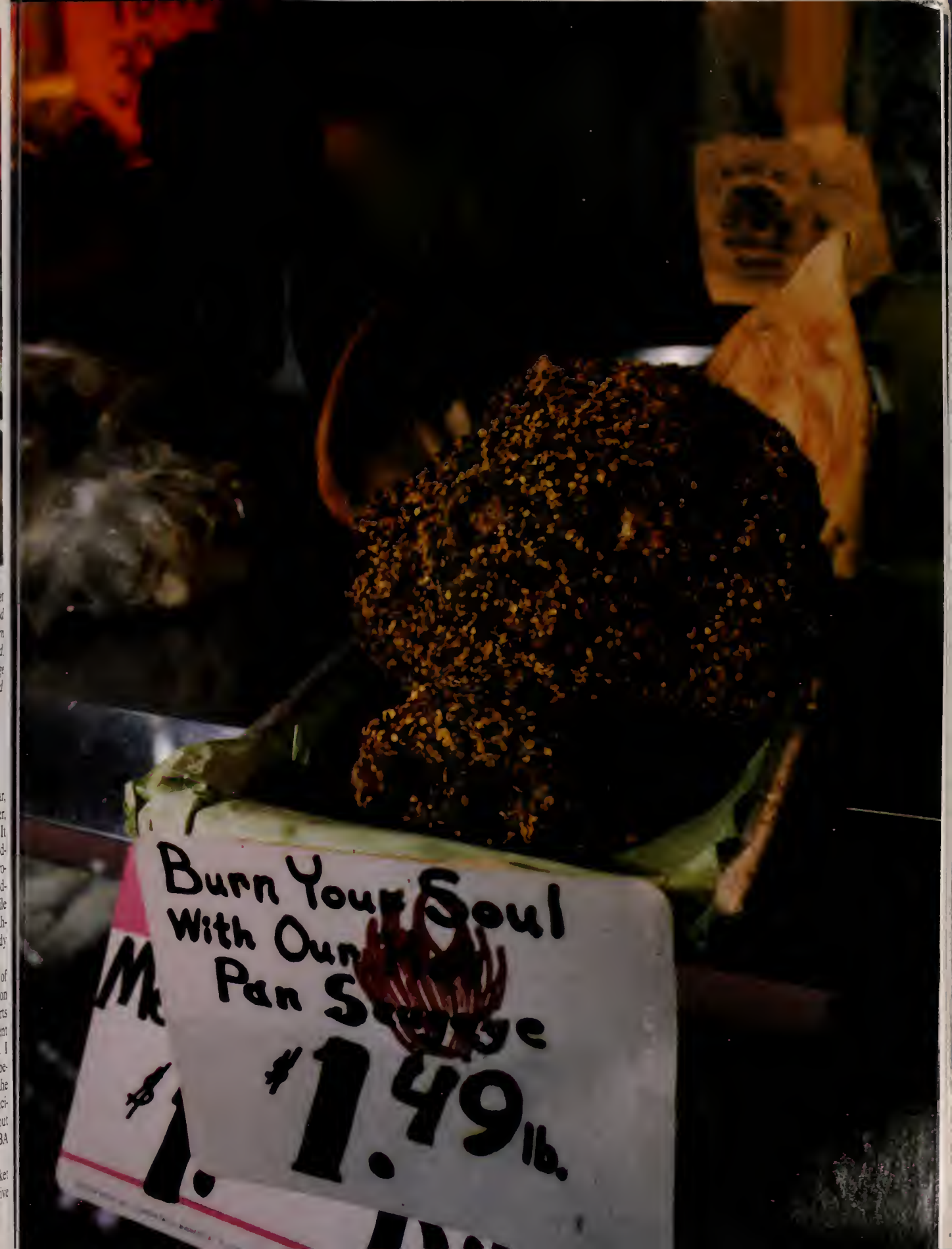
The best grits I ever ate were the baked cheese grits served at a fund-raising event in Lexington, Kentucky, during Derby week (see recipe). Cheese grits are meant as a side dish to go with a meat meal, much as a baked potato might. Served this way, cheese grits are a most refined dish, and you can delight and mystify your friends by including them in an otherwise conventional dinner. Only Sunbelt exiles will be able to identify the dish without prompting.

In addition to pan-southern dishes such as grits, every southern subregion has its own local specialties. Southwestern Louisiana flaunts its crayfish. The town of Vidalia in south Georgia boasts of an extraordinarily mild and sweet yellow onion, officially called the F-1 Yellow Hybrid Granex, but known to serious Georgia cooks as the Vidalia. It is a prized and relatively scarce item in Atlanta. The season runs from mid-May through June. And Georgia gourmets have to check and double check that they are getting the real thing.

For the most part, however, Atlanta cooks operate in the same general culinary atmosphere inherited by other Sunbelt cooks, whether white or black, rich or poor. Details vary, local ingredients differ, but the mixture of fried food, corn products, and West African influence from slave days are all persistent and universal earmarks of Sunbelt cuisine. This unity has obvious historical roots. The South remained an insular, true region much longer than other, more prosperous parts of the country. It had its antebellum tradition as a standard of the good life and it had, gastronomically speaking, an unabashed fondness for a bountiful, cheap, and versatile ingredient that predominates in southern cooking more than all those already named. I refer, of course, to pork.

Pork is the central, basic meat of Sunbelt cookery. From battered bacon to country ham, the hog's various parts are the cuts of historical and current choice below the Mason-Dixon line. I had this impressed on me as never before when I broke away briefly from the ABA to visit Atlanta's fabulous Municipal Market situated a short drive, but worlds away in spirit, from the ABA convention.

In this old-fashioned covered market with its row after row of competitive


Burn Your Soul
With Our
Pan
#1.49 lb.

retail stands, *Sus scrofa* is king. Strolling about, I noticed whole hogs' heads, Georgia hams on hooks, piles of snowy fatback, pigs' tails in heaps, pork chitlins "loose or frozen," hog maws (three pounds for $1.25), pigs' ears and snouts, and an immense mound of pork sausage meat sculpted in the shape of a hog's head. From the ceiling flew a banner urging customers to order fresh whole pigs for July 4.

Faced with such unwonted porcine bounty, I knew that I had come into contact with a vibrant node of local culture. Outside were the skyscrapers of renovated Atlanta, a Manhattanized transplant of northern ways and means, capital of the New South. But in the Municipal Market, an older, possibly shabbier, but far less sterile and deracinated South was profusely on view.

Pork was only the beginning of the riches for sale under that roof. The dazzled shopper could snap up little packets of twigs called yellowroot and steep them for tea. There were tart little red Georgia plums and Crowder peas, double-yolk eggs by the dozen, sassafras honey, greens of several sorts in huge bunches, rabbits, and Rocky Mountain oysters.

A market, by its very existence, presupposes cooks. The Atlanta Municipal Market implies an entire population of families who thrive on a group of foods virtually unknown to shoppers in most northern American supermarkets. Perhaps I was romanticizing what those people do with their hog maws and snouts, but I was seized with a great appetite for dinner at one of their homes.

It was not to be. I ate only in well-known restaurants in Atlanta and never saw a solitary chitlin. Sunbelt food is not fancy food, and it has not turned up on menus in polite places. This does not mean that polite Atlantans turn up their noses at it. Indeed, one of the keys to the survival of this cuisine on its home ground is its continuing appeal to all classes of people, race notwithstanding. At a tony barbecue staged in a leafy suburban backyard for ABA visitors and local friends, the main course was a whole hog cooked on the grill. By the time I arrived, only a charred trotter was left, but I was mollified and uplifted when an Atlantan guest told me where to go later in the year to try opossum.

Raymond Sokolov, a writer with an interest in the history and preparation of food, is editor of Book Digest.



Two recipes from *Four Great Southern Cooks* (available from DuBose Publishing, P.O. Box 924, Atlanta, Georgia 30301, $8.95 postpaid)

Beatrice Mize's Southern-fried Chicken

1 chicken, cut up
Salt
Freshly ground black pepper
1 egg, beaten
Flour
Vegetable shortening for frying

1. Wash the chicken pieces and pat thoroughly dry with paper towels or a clean dishcloth. Sprinkle well with salt and add freshly ground pepper to taste.
2. Beat the egg and thin with a little water. Dip the chicken pieces in the egg mixture, then dredge in the flour. Set the pieces aside on waxed paper.
3. Melt the vegetable shortening over medium high heat in a deep cast-iron skillet. There should be about one-half inch of oil when melted. The oil is ready when it just begins to smoke.
4. Add the chicken pieces to the oil and cook uncovered for about 12 minutes on each side, turning only once. The chicken should be a deep golden brown. Drain on paper towels, place on a platter and serve with cream gravy.

Cream Gravy

2 tablespoons melted vegetable shortening
2 tablespoons flour
1 cup milk or cream
Salt and pepper to taste

Pour off all but two tablespoons of the oil you used to fry the chicken. Add the flour and stir over medium heat with a wooden spoon, scraping the pan until the mixture is blended and beginning to brown. Add the milk or cream and stir until thickened. Add salt and pepper to taste.

Ruth Jenkins's Baked Grits With Cheese

4 cups water
2 cups grits
2 teaspoons salt
1 teaspoon paprika
Dash of Tabasco
4 eggs
1 pound sharp cheddar, grated
8 tablespoons butter

1. Preheat oven to 350 degrees.
2. Boil the water in a saucepan and stir in the grits until thoroughly mixed. Cook until thickened, stirring occasionally.
3. Add salt, paprika, and Tabasco, and remove from heat.
4. In a large mixing bowl, beat the eggs lightly. Add a small amount of hot grits to the eggs, stirring constantly so that the eggs do not cook. Gradually stir in the remaining grits.
5. Add the grated cheese and butter and mix well. Pour into a buttered 2-quart casserole and bake for 45 to 50 minutes. Serve immediately.

Yield: Six servings

FORD EXP

Brand-new two-seat, movin' to the upbeat.

An open road, front-wheel drive, four-wheel independent suspension and enough pure driving excitement for two very lucky people. You get it all in a Ford EXP.

Two front-row seats and a grand opening.



Two plus groceries, or two plus a great weekend, EXP's 29 cubic feet of cargo room can hold it all. And EXP options like flip-up open air roof can make it all the more exciting.



Just between you and EXP.

You can learn a lot behind the wheel of an EXP. Smart little gauges report on your



RPMs, oil pressure, amperes and temperature. You'll know the time. You'll even know the sports scores if you turn on the AM radio, because that's standard, too. (May be deleted for credit.) A special warning light will even tell you if your door is ajar.

Exciting numbers.

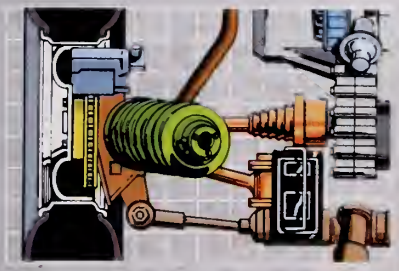
EXP's 1.6 liter CVH engine and four-speed transaxle, with fourth gear as standard overdrive, produce the kind of numbers that keep your driving fun.

46 EST HWY **29** EPA EST MPG

For comparison. Your mileage may differ depending on speed, distance and weather. Actual highway mileage will be lower.

Front-wheel drive, four-wheel independent suspension, fantastic!

EXP's front-wheel drive, four-wheel fully independent suspension and front stabilizer bar are specially tuned for sporty handling. Combine that with EXP's rack and pinion steering, standard power front



disc brakes and sport close-ratio transmission option and you'll get a whole new appreciation for the street where you live. Whether you buy or lease, see EXP at your Ford Dealer now.

FORD EXP

FORD DIVISION Ford



LOOK OUT WORLD. HERE COMES FORD.

Ford

THE TASTE BEYOND 12-YEAR-OLD SCOTCH



Discover more.

Let your mature taste lead you from the finest premium Scotch on up to the most expensive 12-year-old Scotch in the world. The Glenlivet. The ultimate in Scotch.

Most premium Scotch is blended and depends on several whiskies for taste and smoothness.

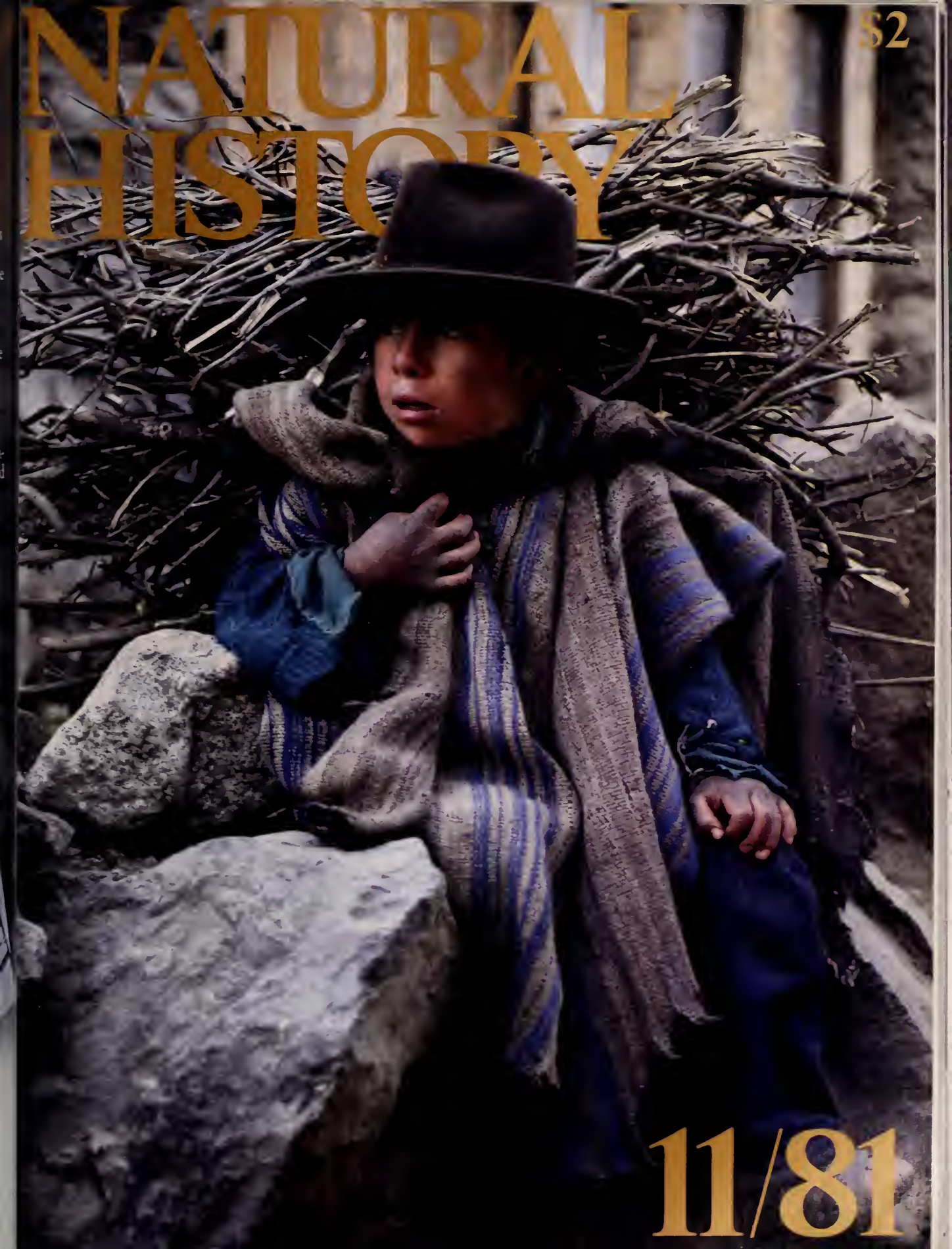
Yet the unblended character of The Glenlivet is noble enough to stand alone. In this distinctive Scotch whisky you'll experience an exceptional smoothness and full-bodied richness, unmatched in all other premium Scotch.

Try the taste beyond premium Scotch.

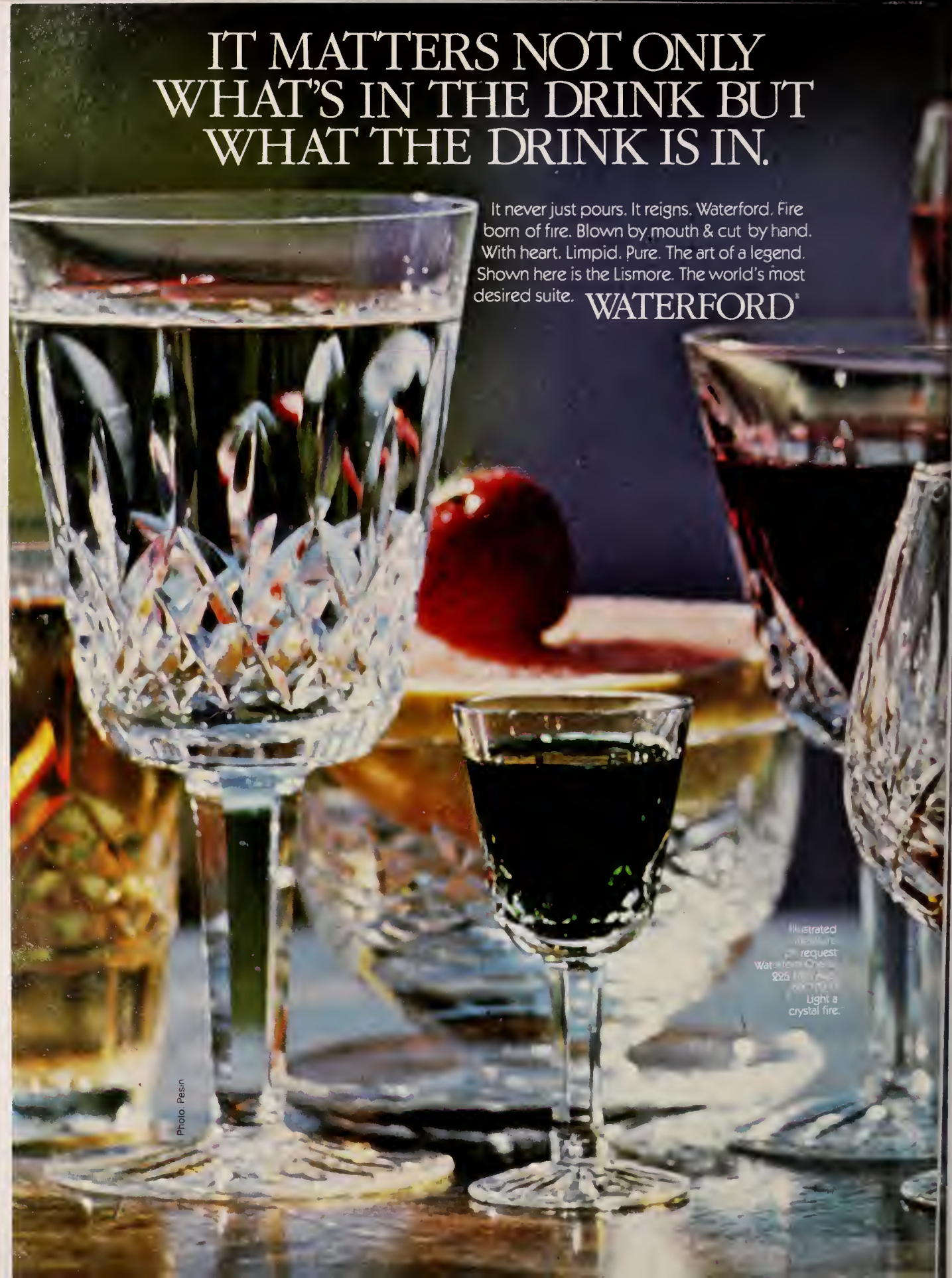
The Glenlivet
Unchanged since 1824.

NATURAL HISTORY

$2



11/81


IT MATTERS NOT ONLY
WHAT'S IN THE DRINK BUT
WHAT THE DRINK IS IN.
It never just pours. It reigns. Waterford. Fire
born of fire. Blown by mouth & cut by hand.
With heart. Limpid. Pure. The art of a legend.
Shown here is the Lismore. The world's most
desired suite.
WATERFORD
Illustrated
request
Light a
crystal fire.
Photo: Pesin

NATURAL HISTORY

Vol. 90, No. 11, November 1981

American Museum of Natural History
Robert G. Goelet, President
Thomas D. Nicholson, Director

2 Authors

7 This View of Life *Stephen Jay Gould*
The Ultimate Parasite

16 A Naturalist at Large *Milton Love*
With a Little Help from My Friends

20 Ralph Hoffmann: Unsung Guide to the Birds *Harold Swanton*
A bird in the bush is worth something.

32 Sky Reporter *Stephen P. Maran*
Getting Ready for Halley

40 Celestial Events *Thomas D. Nicholson*

46 Hare Trigger *John P. Bryant*
In the race of life, the plant sometimes beats the hare.

54 In Praise of Plains *Marilyn Coffey*
"The nerves stiffen, the senses expand, and man begins to realize the magnificence of being."

62 A Least Tern Makes a Right Turn *Barbara W. Massey*
Photographs by George D. Lepp
Ornithologists are now looking for the bird's Mexican hideaway.

72 Weathering Heights *Charles A. Weitz*
Harsh mountain environments take a toll on their inhabitants.

88 Additional Reading

96 Bios *Robert E. Cook*
Pin Cherry Perceptions

104 At the American Museum
Patterns of Paradise

110 Books in Review *John P. Kelsall*
Following the Caribou

116 A Matter of Taste *Raymond Sokolov*
Cut and Dried

Cover: *In the Huayhuash Mountains, northeast of Lima, Peru, a Quechua boy pauses to rest with a load of scarce firewood. Photograph by John Maddock Roberts. Article on page 72.*

Alan Ternes, Editor
Judith Friedman, Managing Editor
Thomas Page, Designer
Board of Editors: Carol Breslin, Sally Lindsay, Frederick Hartmann, Vittorio Maestro, Rebecca B. Finnell
Florence G. Edelstein, Copy Chief
Rita Campon, Copy Editor
E. Kay Danzig, Art Asst.
Kay Zakariasen, Picture Editor
Lauren Krenzel, Photo Research
Douglas J. Preston, Publications Editor
Annie R.C. Finch, Editorial Asst.
Lillian Berger
Editorial Advisers: Malcolm Arth, James W. Atz, Niles Eldredge, Kenneth L. Franklin, E.Craig Morris, Norman Newell, Thomas D. Nicholson, Martin Prinz, Gerard Piel, Nina Root

David D. Ryus, Publisher
Bradford D. Smith, Business Manager
Frederick E. Grossman, Production Mgr.
Debra Buck McCord, Asst. Production Mgr.
Ernestine Weindorf, Administrative Asst.
Elaine M. Callender, Advtg. Production Mgr.

Cary Castle, Circulation Manager
Ramón E. Alvarez, Circulation Asst.

Natural History *(ISSN 0028-0712), incorporating Nature Magazine, is published monthly by the American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024. Subscriptions: $15.00 a year. In Canada and all other countries: $18.00 a year. Second-class postage paid at New York, N.Y. and at additional offices.*

Copyright © 1981 by American Museum of Natural History. All rights reserved. No part of this periodical may be reproduced without written consent of Natural History. *The opinions expressed by authors do not necessarily reflect the policy of the American Museum.* Natural History *is indexed in* Reader's Guide to Periodical Literature.

Advertising Offices:
Natural History Sales
488 Madison Avenue
New York, N.Y. 10022
President of Sales, Arthur Hill Diedrick
Advertising Manager, Katherine José

Telephone Numbers:
Advertising Sales (212) 826-9467
Museum Information (212) 873-4225
Subscription Orders (800) 247-5470
(800) 532-1272 (in Iowa)

Change of address notices, undeliverable copies, orders for subscriptions, and other mail items are to be sent to
Natural History Membership Services
Box 4300
Bergenfield, New Jersey 07621

Authors



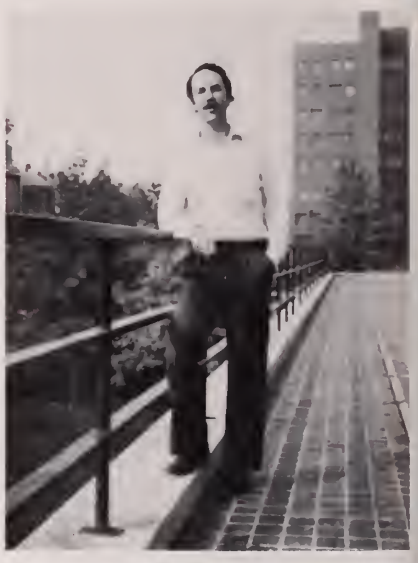
During the winter of 1972–73, when **John P. Bryant** was living in bush Alaska, he had the opportunity to observe a "particularly dramatic oscillation of the snowshoe hare population." Since that time, his research has concentrated on why hare populations do not recover as rapidly after a crash as do the severely browsed plants on which they feed. Bryant is currently a doctoral candidate at the University of Alaska in Fairbanks and a research associate at the university's Institute of Arctic Biology. When not observing hares, dog sledding, or building his log home, he enjoys traveling to more tropical climes to watch reef fish—"a nice break from the Alaskan winter."



Deep ties to the Midwest, especially Nebraska, where she was born and raised, prompted **Marilyn Coffey** to write a series of essays tracing the history of the Great Plains. These essays, including "The Dust Storms," which appeared in *Natural History*, February 1978, are to form the chapters of a forthcoming book, *American Gothic*. A graduate of the University of Nebraska with a bachelor's degree in journalism, Coffey is an assistant professor of English at Pratt Institute in Brooklyn and the recipient of the University of Nebraska's Master Alumnus Award for distinguished achievement in writing. She recently received a Master of Fine Arts degree in creative writing from Brooklyn College.

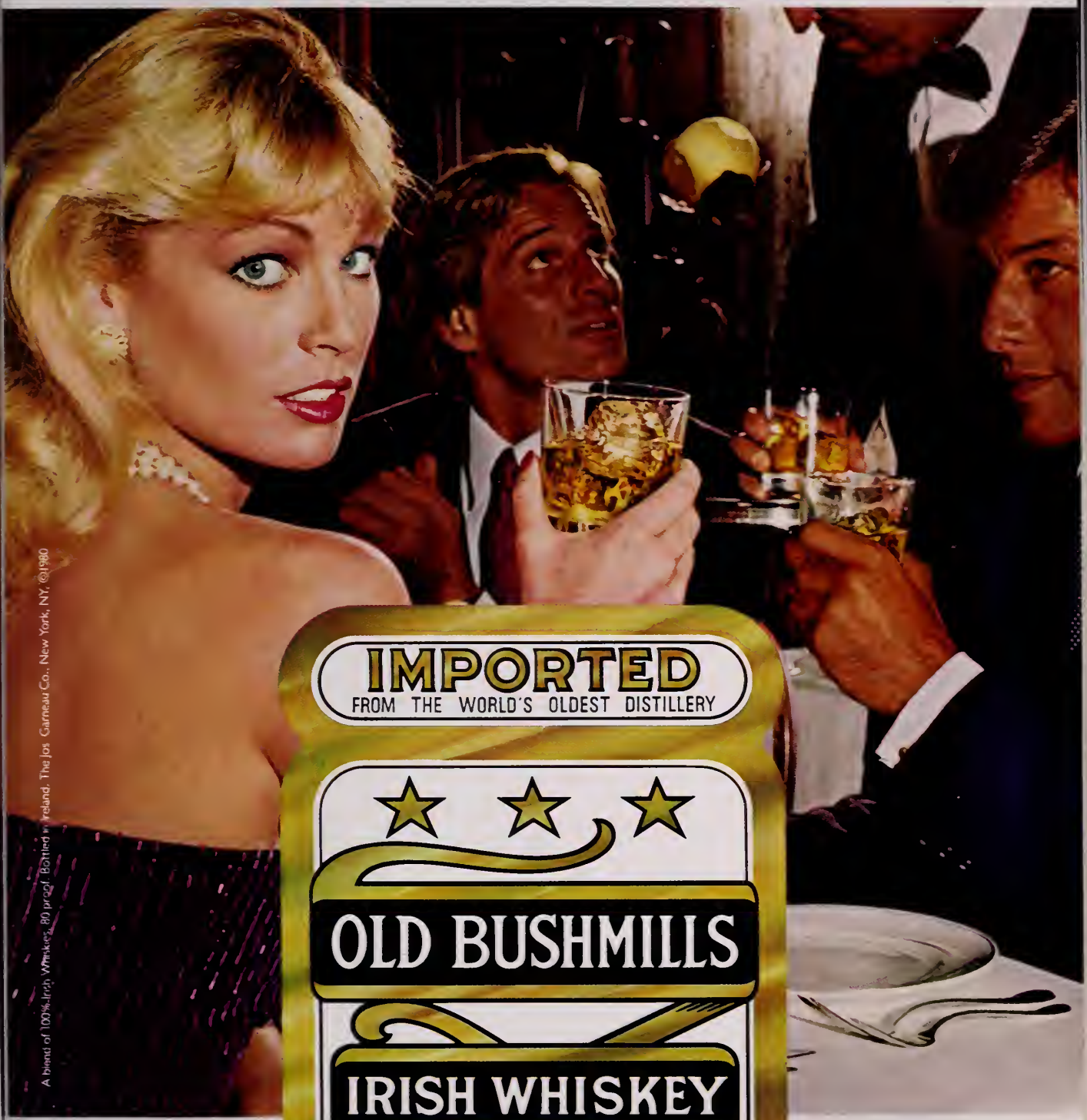
After working for twenty years in medical research laboratories, **Barbara W. Massey** entered graduate school in 1970 at California State University, Long Beach, and changed careers. Her master's thesis project was a study of the breeding biology of the California least tern. This bird, along with another endangered species—the light-footed clapper rail—has been the focus of her research during the past decade. A third pursuit, which she tries to fit into her schedule, is the study of the vocalizations and behavior of all species of the small *Sterna* terns. Massey is also a biological consultant in ornithology to the U.S. Fish and Wildlife Service, the California State Fish and Game Commission, the U.S. Bureau of Land Management, and the U.S. Army Corps of Engineers.





Physical anthropologist **Charles A. Weitz** became involved in studying people who live at high altitudes when he was invited as a graduate student to participate in a research project in Nuñoa, Peru. Having long felt an enthusiasm for south Asian cultures, Weitz later did fieldwork among the Sherpas in the Khumbu region of Nepal. His most recent research, in the Peshawar Basin of northwestern Pakistan, concerns the demographic and epidemiological changes caused by the introduction of irrigated agriculture. Weitz has been an assistant professor of anthropology at Temple University in Philadelphia since 1974.

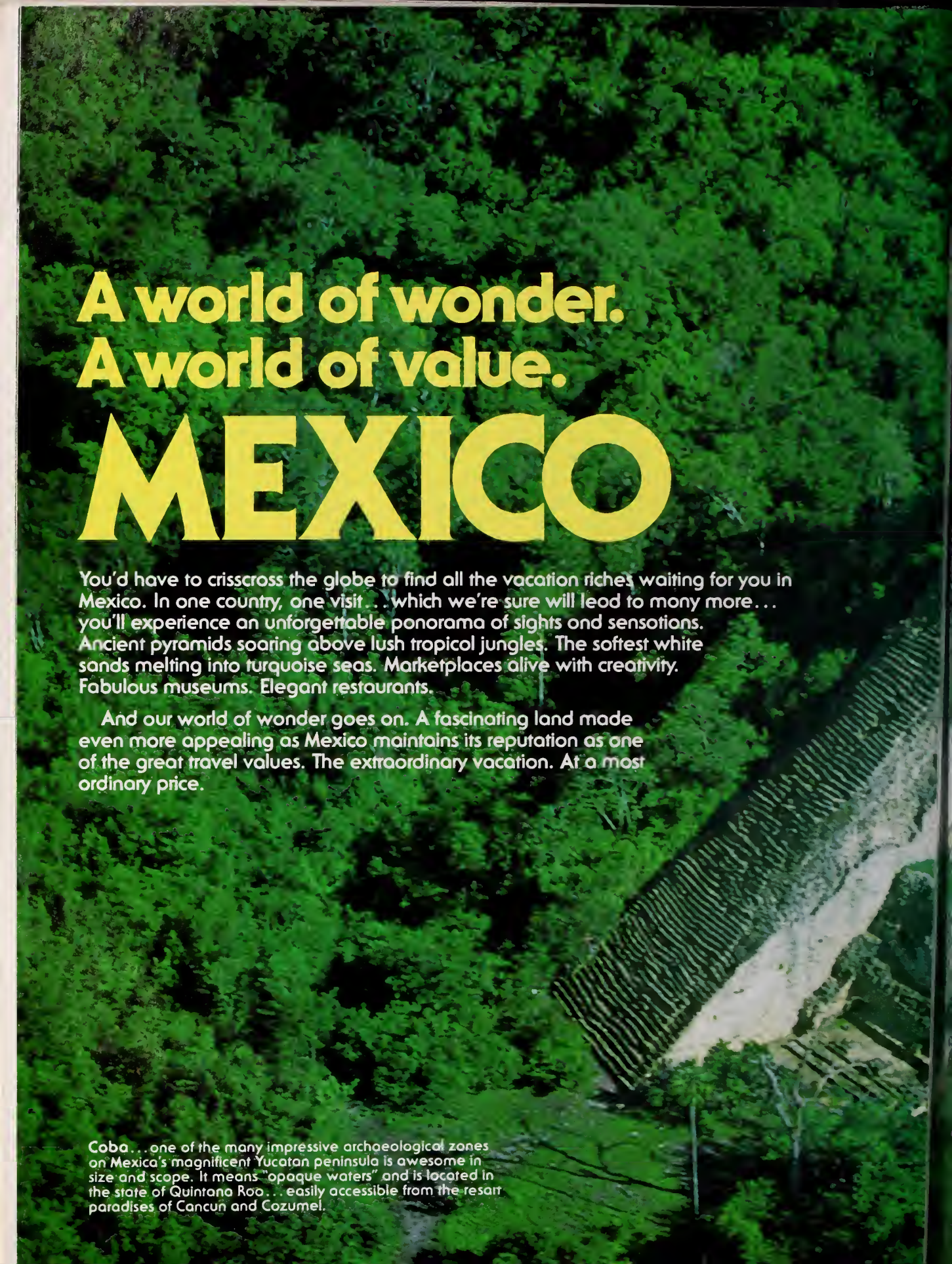
Old Bushmills.
It's changing people's minds about Irish Whiskey.

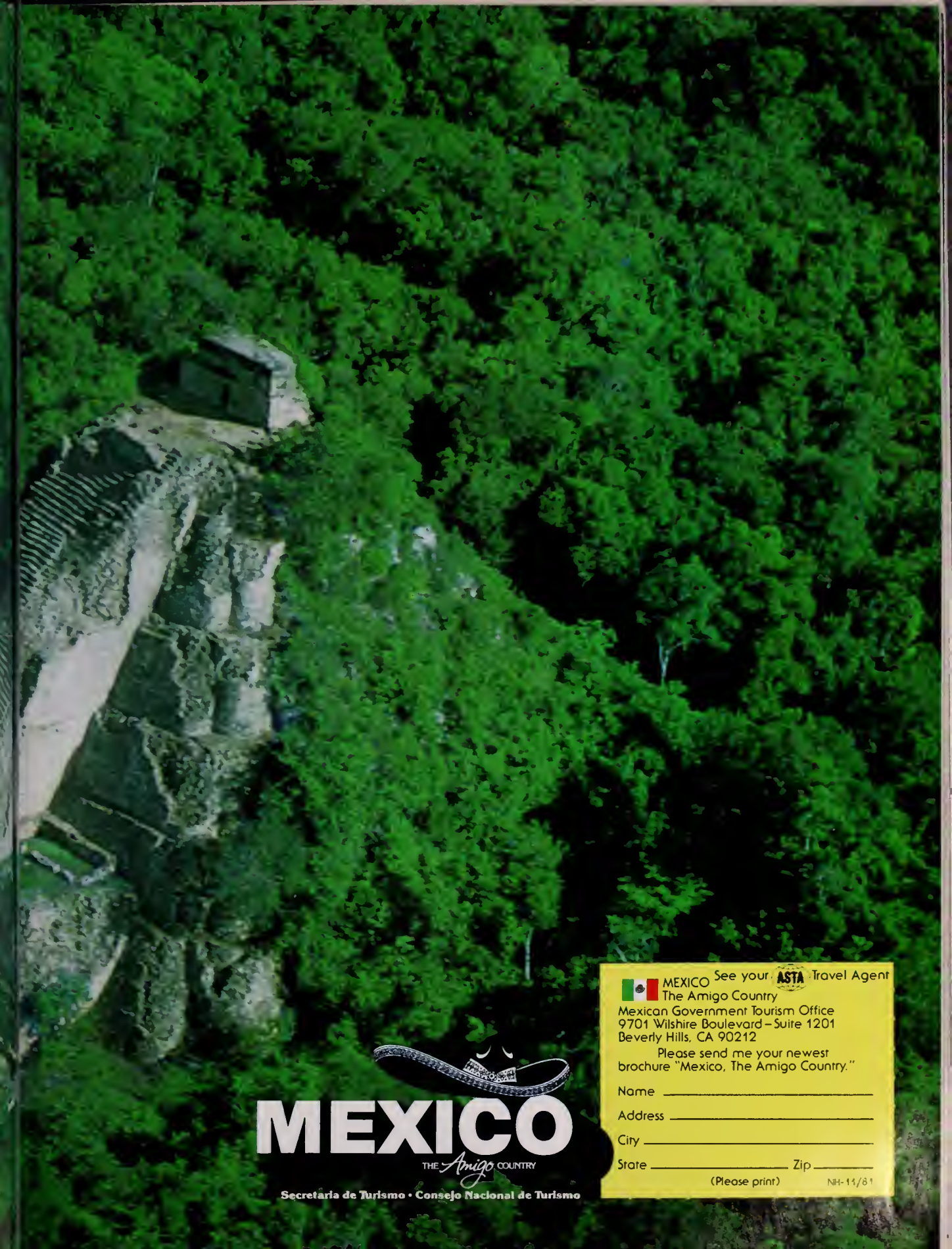


A blend of 100% Irish Whiskies, 80 proof. Bottled in Ireland. The Jos. Garneau Co., New York, NY. ©1980

For free food and drink recipes, write to Old Bushmills, P.O. Box 639, New York, New York 10018. To send Old Bushmills anywhere in the country, call toll free: (800) 528-6148. Void where prohibited.

Experience the taste that experience created.
Old Bushmills
Since 1608.


A world of wonder.
A world of value.
MEXICO
You'd have to crisscross the globe to find all the vacation riches waiting for you in Mexico. In one country, one visit . . . which we're sure will lead to many more . . . you'll experience an unforgettable panorama of sights and sensations. Ancient pyramids soaring above lush tropical jungles. The softest white sands melting into turquoise seas. Marketplaces alive with creativity. Fabulous museums. Elegant restaurants.
And our world of wonder goes on. A fascinating land made even more appealing as Mexico maintains its reputation as one of the great travel values. The extraordinary vacation. At a most ordinary price.
Coba . . . one of the many impressive archaeological zones on Mexico's magnificent Yucatan peninsula is awesome in size and scope. It means "opaque waters" and is located in the state of Quintana Roo . . . easily accessible from the resort paradises of Cancun and Cozumel.



MEXICO

THE *Amigo* COUNTRY

Secretaría de Turismo • Consejo Nacional de Turismo

MEXICO
The Amigo Country

See your ASTA Travel Agent

Mexican Government Tourism Office
9701 Wilshire Boulevard – Suite 1201
Beverly Hills, CA 90212

Please send me your newest brochure "Mexico, The Amigo Country."

Name _____

Address _____

City _____

State _____ Zip _____

(Please print)

NH-11/81

GO TO THE POST OFFICE AND DRIVE OFF WITH A CELEBRITY.

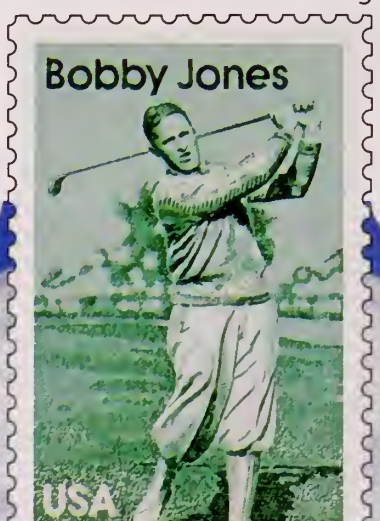
Bobby Jones, one of the most famous golfers of all time, is waiting for you on the newest U.S. Commemorative stamp.

Over 50 years ago, Jones won the Grand Slam. No one since has equalled that feat. And now you can bring that accomplishment home, with this handsome stamp.

But that's just one small part of the America you can explore through U.S. Commemoratives. Every few weeks another new issue honors this country's heroes. History. And natural beauty.

There's no better time than right now to get started on this intriguing hobby.

So come to the Post Office and discover stamp collecting. When you drive off with the Bobby Jones stamp, you'll feel like a pro.



U.S. Postal Service

© USPS 1981

The Ultimate Parasite

What happens to bodies if genes act for themselves?

by Stephen Jay Gould

The uncommon good prose of scientists is more often spare than flowery. In my favorite example, James D. Watson and Francis Crick used less than a page to announce their structure of DNA in 1953. They began with the sparsest announcement: "We wish to suggest a structure for the salt of deoxyribose nucleic acid (D.N.A.). This structure has novel features which are of considerable biological interest." And they ended with a reminder that they had not overlooked a major point just because they had chosen to defer its discussion: "It has not escaped our notice that the specific pairing we have postulated immediately suggests a possible copying mechanism for the genetic material" (that is, the two strands of the double helix would pull apart and each then act as a template for the reconstitution of its partner).

Francis Crick, now a professor at the Salk Institute in southern California, has continued to generate controversial, challenging hypotheses (and he has often been right). In late 1981, he will publish a book, *Life Itself*, advocating a theory of "directed panspermia"—the idea that Earth's original life arrived as microorganisms dispatched by intelligent beings who chose not to make the long journey themselves. (Ten will get you fifty that he's wrong this time—but only fifty; he's been right too often.)

Crick has also not lost his gift for a well-turned phrase. In the presentation of his latest controversial hypothesis, published a year ago in *Nature* (April 17, 1980) with Salk colleague Leslie Orgel as first author, he outdid the last line of his 1953 paper with Watson. Orgel and Crick conclude: "The main facts are, at first sight, so odd that only a somewhat unconventional idea is likely to explain them." Indeed, the facts are so interesting, and the wondering about them so intense, that the same issue of *Nature* carried an accompanying article by Dalhousie University biologists W. Ford Doolittle and Carmen Sapienza, who had, quite independently, devised the same explanation and argued the case, in many ways, more forcefully.

What, then, are these disturbing facts? When a younger Crick determined the structure of DNA in 1953, and others cracked the genetic code a few years later, everything seemed momentarily to fall into order. The old idea of genes as beads on a string (the chromosome) seemed to gain its vindication from the Watson-Crick model. Each three nucleotides in DNA codes for an amino acid (via an RNA intermediary); a string of amino acids makes a protein. Perhaps we could simply read down a chromosome to find genes lined up, one after the other, each ready to begin the assembly of its essential part.

It was not to be so. Is it ever? We now know that the genetic material of higher organisms is vastly more complex. Many genes come in pieces, separated in DNA by sequences of nucleotides that are not transcribed into RNA. Many proteins are coded by partial sequences on two or more chromosomes. What controls regulate their assembly? (Human globin, the protein component of hemoglobin, contains alpha and beta chains—and the genes for each chain are on separate chromosomes.)

Even more disturbing (and exhilarating) is the discovery, made more than a decade ago but gathering intensity ever since, that only a small percentage of DNA codes for proteins in higher organisms—and that these are the only bits of DNA whose function we may truly understand at the moment. In humans, somewhat more than 1 percent, but not as much as 2 percent, of DNA codes for proteins. Much of the rest contains sequences that are repeated over and over again—hundreds or thousands of identical (or nearly identical) beads, sometimes following one after the other, sometimes dispersed widely over several chromosomes. Why so many copies? What do they do? The "selfish DNA" hypothesis of Doolittle, Sapienza, Orgel, and Crick provides an unusual answer to the puzzling question of why so much DNA exists in repeated copies (but I will keep you in suspense for a bit and discuss the conventional answers first).

Higher organisms contain different classes of repeated DNA. One type, called highly repeated or satellite DNA, contains short and simple sequences repeated hundreds of thousands or millions of times; 5 percent or so of human DNA falls into this class. We hardly have a clue about the origin and function of satellite DNA; neither the selfish DNA hypothesis nor the conventional hypotheses can explain it. Satellite DNA is, as they say, a "whole 'nother" story waiting to be told.

The current debate over the conventional and selfish DNA hypotheses centers upon the so-called intermediate or middle-repetitive DNA, some 15 to 30 percent of both the human and the fruit fly genome. Middle-repetitive DNA exists in tens to a few hundred copies per sequence; the copies are often widely dispersed on several chromosomes.

I have said nothing, so far, about the DNA of simpler organisms—the prokaryotic bacteria and blue-green algae, which have no nucleus and carry their DNA in a single chromosome. The DNA of prokaryote (prenucleate) organisms is "better behaved" with reference to the original hopes of the Watson-Crick model. Most bacterial DNA is single copy and protein coding, almost those beads on a string after all. But even prokaryotes are not immune to repetition. A hot topic of late concerns the presence in prokaryotes of so-called transposons, transposable elements, or more colorfully, jumping genes. These sequences of DNA, as their various names proclaim, can repeat themselves and then autonomously move about to other positions on the bacterial chromosome. They often exist in about as many copies as middle-repetitive DNA in eukaryotes (higher organisms with a nucleus and paired chromosomes). This has led many biologists to propose that at least some of the middle-repetitive DNA in higher organisms amplifies itself by the same mechanism of transposition. (The selfish DNA hypothesis assumes a correspondence between pro-

L.L.Bean®

Outdoor Sporting Specialties



Chamois Cloth Shirt

(For Men, Women and Children)

Mr. Bean's favorite hunting and fishing shirt. Well made from a 7 oz. cotton flannel, thickly napped on both sides. Warm, wind resistant and comfortable to wear. Machine Wash. Six colors: Navy. Bright Red. Tan. Forest Green. Slate Blue. Ivory. Men's regular sizes: 14½ to 20. #1611W. **$17.00 ppd.** Men's long sizes: 15 to 19. #1612W. **$18.25 ppd.** Women's sizes: 6 to 20. #4311W. **$17.00 ppd.** Children's sizes: 8 to 18. #4335W. **$15.75 ppd.** (No Ivory).

Flannel Sheets



Take the chill out of getting in bed on cool evenings. Made of a tightly woven, softly napped flannelette fabric. 80% cotton, 20% polyester. Whipstitched ends. Machine Wash and Dry. Colors: White/Blue Stripes. White/Pink Stripes. White/Gold Stripes. Cut generously to allow for normal shrinkage. Three sizes: #7481W Twin (70"x 100"). **$12.00 ppd.** #7488W Double (80"x 100"). **$13.50 ppd.** #7489W Queen (90"x 104"). **$16.50 ppd.** King size available in 65% polyester, 35% cotton (102"x 102"). Solid colors: Beige. White. Sky Blue. #7464W **$18.00 ppd.**



Wood Carrier

Manufactured by us from heavy duck. Leather handles are rounded for a comfortable grip. A practical arrangement for carrying stove or fireplace wood. No dirt or bark on the floor with this convenient carrier. Size 20" x 42". #8731W. **$9.75 ppd.**

Corduroy Work Pants



Same comfortable pattern as our popular Chino Pants. Full cut, yet neat in appearance. Durable medium weight corduroy is 84% cotton and 16% polyester. Machine Washable. Two front, two rear pockets; 1¾" belt loops. "Easy alter" waistband can be expanded 1½". Even waist sizes: 30 to 44. Inseams: 29", 31" and 33". Two colors: #2815W. Navy. #2816W. Tan. An exceptional value at **$18.00 ppd.**



FREE Fall Catalog

Features practical apparel and footwear for men, women and children; hunting, hiking and winter sports equipment. Many items of our own manufacture. All fully guaranteed. Our 69th year of providing dependable outdoor sporting specialties.

Ship Postage Paid — 100% Guarantee

Item#	Qty.	Color	Size	Description	Price

Add 5% Maine Sales Tax On Shipments To Maine Addresses — TOTAL

☐ Check Enclosed ☐ Master Card ☐ VISA ☐ American Express

Card Number_____

Exp. Date_____ ☐ **PLEASE SEND FREE CATALOG**

Name_____

Address_____

City_____ State_____ Zip_____

L. L. Bean, Inc., 771 Casco St., Freeport, ME 04033

karyote transposons and the source of middle-repetitive DNA in eukaryotes. Some middle-repetitive DNA probably arises in other ways, and selfish DNA will therefore not explain all of it.)

Conventional arguments for the existence of middle-repetitive DNA follow the usual Darwinian perspective. Evolution is about the struggle of individuals (bodies) to leave more surviving offspring in future generations. This struggle operates by natural selection and selection is a potent editor. Major features of organisms—and some 25 percent of the genetic material cannot be minor—must exist because they provide some advantages to individuals in the struggle for life. We must, in other words, find a function for middle-repetitive DNA in terms of advantages to the bodies that carry it.

Rumblings of claims for nonadaptive and nonfunctional status have been heard from time to time (selfish DNA is the first, and more subtle, explosion for this perspective). Still, as Doolittle and Sapienza detail in their article, the overwhelming majority of proposals have hewed to Darwinian orthodoxy: they assume that middle-repetitive DNA cannot exist in such amounts unless it confers direct adaptive benefits upon organisms. (I will save myself some words from now on by simply writing "repetitive DNA" when I mean only "middle-repetitive DNA.")

The conventional adaptationist hypotheses have fallen into two classes: one, I believe, obviously wrong on (unrecognized) principle; the other undoubtedly correct in part (I do not believe that all repetitive DNA is selfish DNA). The unreasonable arguments postulate what I like to call a "retrospective significance" for repetitive DNA—that is, they justify its existence by discussing the benefits it may confer upon distant evolutionary futures.

Suppose all working genes could only exist in one copy that coded for an essential protein. How then could substantial evolutionary change ever occur? What will supply the essential protein while evolution monkeys about with the only coding sequence that produces it? But if a gene can repeat itself, then one copy might continue to code for the essential protein, leaving the other free to change. Thus, potential flexibility for evolutionary change has often been cited as the primary significance of repetitive DNA.

I have no quarrel with the idea that redundancy may supply the flexibility that evolution requires for initiating ma-

WHY PEOPLE WHO DON'T JOIN BOOK CLUBS ARE JOINING QPB

Four reasons: Great books. Great authors. Great savings. Great editions.

QPB books are softcover editions in hardcover sizes, durably bound and printed on fine paper. But they cost up to 65% less than their hardcover counterparts.

You don't judge a book by its cover, so why pay for the cover?



256



439

256. **James Beard's American Cookery.** James Beard
Hardcover: $15.95 QPB: $7.95

266. **The Moveable Nest** Tom Schneider. QPB: $7.50

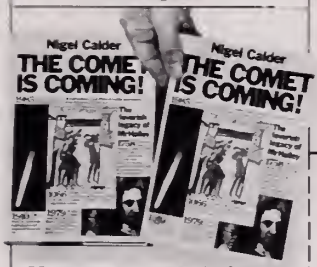
386. **Rapid Viz:** A New Method for the Rapid Visualization of Ideas. Kurt Hanks and Larry Belliston
QPB: $6.50

439. **Woody Allen Set:** *Side Effects, Without Feathers, Getting Even* (3 Vols., Boxed) Woody Allen
Hardcover: $26.85 QPB Ed: $10.95

443. **On Language.** William Safire
Hardcover: $12.95 QPB Ed: $6.95

149. **Peter the Great** His Life and World. Robert K. Massie
Hardcover: $19.95 QPB: $7.95

Compare



Hardcover: $12.95 **QPB Softcover: $7.50**

257. **The Comet Is Coming!** The Feverish Legacy of Mr. Halley. Nigel Calder
Hardcover: $12.95 QPB Ed: $7.50

357. **Distant Stars** Samuel R. Delany. QPB: $6.95

449. **Movie Facts and Feats** A Guinness Record Book. Patrick Robertson
Hardcover: $17.95 QPB Ed: $9.95

458. **The Thirties:** From Notebooks and Diaries of the Period. Edmund Wilson. Edited with an Introduction by Leon Edel
Hardcover: $17.95 QPB Ed: $8.95

462. **Mathematical Magic Show and Mathematical Circus.** (2 Vols.) Martin Gardner
Hardcover: $18.90 QPB: $7.90

435. **The Unusual-by-Mail Catalog** by The Print Project Prudence McCullough, Editor
Hardcover: $14.95 QPB: $7.95

100. **The Almanac of American Letters.** Randy F. Nelson
Hardcover: $16.95 QPB: $7.95

121. **Gödel, Escher, Bach** An Eternal Golden Braid. Douglas R. Hofstadter. QPB: $7.95

166. **Backpacking:** One Step at a Time. (Revised 1980s Edition) Harvey Manning. QPB: $3.95

384. **Oxford American Dictionary** Compiled by Eugene Ehrlich, Stuart Berg Flexner, Gorton Carruth, Joyce M. Hawkins
Hardcover: $14.95 QPB: $4.95

371. **The Concise Oxford Dictionary of Music.** (Third Edition) Michael Kennedy
Hardcover: $19.95 QPB: $8.95

405. **Let's Go:** The Budget Guide to Europe 1981-82. Edited by Jonathan Hand
QPB: $6.95

Join now. Pick any 3 books or sets for $1 each – with no obligation to buy another book.

356. **Gnomes.** Text by Wil Huygen Illustrated by Rien Poortvliet
Hardcover: $17.50 QPB: $8.50

191. **A Treasury of Modern Fantasy** Edited by Terry Carr and Martin Harry Greenberg. QPB: $7.15

571. **The Basic Book of Photography,** Revised Edition. Tom Grimm. QPB: $6.50

229. **Starting to Draw** Wendon Blake. QPB: $5.95

324. **How to Buy Money:** Investing Wisely for Maximum Return. Wayne Nelson
Hardcover: $10.95 QPB Ed: $6.95

398. **The Dinosaurs.** Illustrated by William Stout, Narrated by William Service, Edited and Produced by Byron Preiss, Introduction and Scientific Commentary by Dr. Peter Dodson, University of Pennsylvania
QPB: $10.95

635. **Drawing on the Right Side of the Brain:** A Course in Enhancing Creativity and Artistic Confidence. Betty Edwards
Hardcover: $13.95 QPB: $6.95

111. **The Search for Alexander** An Exhibition. Contributions by Nicholas Yalouris, Manolis Andronikos, and Katerina Rhomiopoulou. (Photographs)
Hardcover: $24.95 QPB: $9.95

328. **The Arbor House Treasury of Horror and the Supernatural** Compiled by Bill Pronzini, Barry N. Malzberg and Martin H. Greenberg With an introduction by Stephen King. Hardcover: $19.95 QPB: $7.15

151. **The Lord of the Rings** (3 Vols., Boxed) J.R.R. Tolkien
Hardcover: $32.95 QPB: $9.95

330. **The Poetry of Robert Frost** Edited by Edward Connery Lathem
Hardcover: $14.95 QPB: $6.95

181. **The Chinese:** Portrait of a People. John Fraser
Hardcover: $14.95 QPB Ed: $7.95

327. **Riddley Walker.** Russell Hoban
Hardcover: $12.95 QPB Ed: $6.95

284. **The Last Laugh.** S. J. Perelman
Hardcover: $12.95 QPB Ed: $6.95

381. **The New York Times Book of Wine.** Terry Robards
Hardcover: $14.95 QPB: $5.95

Let's try each other for 6 months.

Quality Paperback Book Club, Inc., Middletown, Pa. 17057.
Please enroll me in QPB and send the 3 choices I've listed below. Bill me $3, plus shipping and handling charges. I understand that I am not required to buy another book. You will send me *QPB Review* (if my account is in good standing) for 6 months. If I have not bought and paid for at least 1 book in every six-month period, you may cancel my membership. A shipping and handling charge is added to each shipment.

QB 113-11

Indicate by number the 3 books or sets you want ☐ ☐ ☐

Name _____ 1-16

(Please print clearly)

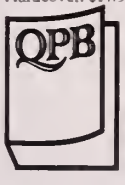
Address _____ **Apt.** _____

City _____ **State** _____ **Zip** _____

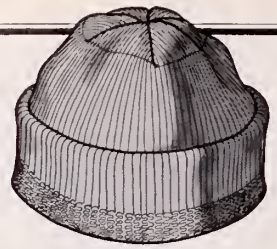
How membership works.

1. You receive **QPB Review** 15 times each year (about every 3½ weeks). Each issue reviews a new **Main Selection,** plus scores of Alternates. All Main Selections with established publisher's prices are offered at *at least* 20% discount off that price.
2. If you want the **Main Selection** do nothing. It will be shipped to you automatically. If you want one or more Alternate books—or no book at all—indicate your decision on the reply form always enclosed and return it by the date specified.
3. **Bonus books for Bonus Points.** For each book or set you take (except the first 3 you get for $1 each), you earn Bonus Points which entitle you to choose any of the books we offer; you pay only shipping and handling charges.
4. **Return privilege.** If *QPB Review* is delayed and you receive the **Main Selection** without having had 10 days to notify us, you may return it for credit at our expense.
5. **Cancellations.** You may cancel membership at any time by notifying QPB. We may cancel your membership if you elect not to buy and pay for at least one book in every six-month period.

Prices generally higher in Canada.



The first book club for smart people who aren't rich.



AUTHENTIC WATCH CAP

This is the genuine article, made for us by the mill that knits them for the military. Warm and strong worsted wool is knit tight and flat to keep its shape. Wear the cuff doubled or pulled down to protect ears, neck and forehead. Rolls for stowing in gear bag or glove box. One size fits all. **Colors:** Navy Blue or Gold. **Wool Watch Cap $5.50** postpaid.

Order Today! Money Back Guarantee!

Here is my check or money order for $ _____
(Add sales tax where applicable.)

#1760 Wool Watch Cap Color _____

Name _____

Address _____

City _____

State _____ Zip _____

☐ **Please send me your FREE color catalog of quality outdoor apparel and equipment.**

Eddie Bauer®

Dept. MNH, Fifth & Union, Seattle, WA 98124



Make Spline Maple

This is not a lowly pun, but in woodworkers' parlance refers to the use of a third piece, or spline, to join two pieces of wood together. There are even blind and multiple spline joints.

Fine Woodworking magazine speaks this language to more than 200,000 readers—people seriously interested in making beautiful things out of wood. Whether you are an aspiring novice or an accomplished expert, you'll find it an especially informative magazine, with finely detailed articles about techniques and tools, materials and design. It's written by master craftsmen who share their many years of woodworking experience. And it's printed on heavy paper to withstand years of reference. All back issues are in print and indexed periodically.

If you want to become a better woodworker, send $14.00 for a one-year subscription (Visa or MasterCard accepted). Or call us toll-free, 1-800-243-7252 (in Connecticut, 1-426-8171). If you're not pleased, we'll be happy to refund.

Fine WoodWorking®

The Taunton Press
52 Church Hill Rd.
P.O. Box 355CW
Newtown
Connecticut 06470

jor changes. Susumu Ohno, who first popularized this idea in 1970 in a brilliant book (*Evolution by Gene Duplication*), argued that, without redundancy "from a bacterium only numerous forms of bacteria would have emerged." Duplication supplies the raw material of major evolutionary change: "The creation of a new gene from a redundant copy of an old gene is the most important role that gene duplication played in evolution."

But think about it for a moment. The argument is sound and may represent, in fact, the major *effect* of gene duplication for evolution. Yet unless our usual ideas about causality are running in the wrong direction, this flexibility simply cannot be the adaptive explanation for why repetitive DNA exists. Selection works on individuals at the moment. It cannot sense what may be of use ten million years hence in a distant descendant. The duplicated gene may make future evolutionary change possible, but selection cannot preserve it unless it confers an "immediate significance." Future utility is an important consideration in evolution, but it cannot be the explanation for current preservation. Future utilities can only be the *fortuitous effects* of other direct reasons for immediate favor.

(The confusion of *current utility* with *reasons for past historical origin* is a logical trap that has plagued evolutionary thinking from the start. Feathers work beautifully in flight, but the ancestors of birds must have evolved them for another reason—probably for thermoregulation—since a few feathers on the arm of a small running reptile will not induce takeoff. Our brains enlarged for a set of complex reasons, but surely not so that some of us could write essays about it. Interested readers may wish to consult a technical article, to appear in *Paleobiology* during 1982, that Elisabeth Vrba and I have written about this subject. We wish to restrict the term *adaptation* only to those structures that evolved for their current utility; those useful structures that arose for other reasons or for no conventional reason at all, and were then fortuitously available for other usages, we call exaptations. New and important genes that evolved from a repeated copy of an ancestral gene can only be exaptations, and their new usage cannot be the reason for the original duplication.)

The second set of adaptive arguments is legitimate in proposing an immediate selective benefit for repeated DNA. If genes move about and insert themselves on different chromosomes, for example, they may occasionally link up with other segments of DNA to form advantageous new combinations. More importantly, much DNA, while not coding for protein itself, may play a role in regulating the DNA that does. This regulatory DNA may turn other genes on and off and may determine the sequence and location of expression for the genes that do code for proteins. If repetitive DNA performs these regulatory functions, then its dispersal throughout the genome can have profound immediate effects. Inserted into a new chromosome, it may turn adjacent genes on and off in new ways and sequences. It may, for example, bring together the products of two genes that had never been in proximity. This new combination may benefit an organism (see the classic article of Roy Britten and Eric Davidson, *Quarterly Review of Biology*, 1971, pp. 111–31).

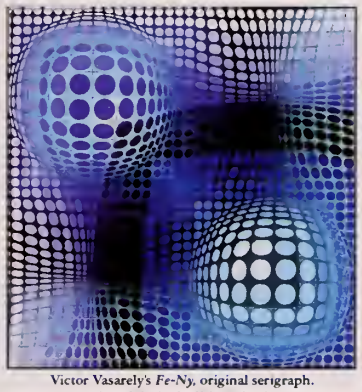
Yet, for all these efforts, the nagging suspicion remains that these adaptive explanations cannot account for all repetitive DNA. There is simply too much of it, too randomly dispersed, too apparently nonsensical in its construction, to argue that each item perseveres because natural selection had favored it in a regulatory role. The selfish DNA hypothesis proposes a fundamentally different explanation for much of this repetition. It is radical in that literal sense of getting to the roots, for it demands that we reassess some basic and usually unquestioned assumptions of evolutionary argument—what Orgel and Crick meant when they spoke of facts "so odd that only a somewhat unconventional idea is likely to explain them."

The argument is simplicity itself once you establish the frame of mind to permit it: if repetitive DNA is transposable, then why do we need an adaptive explanation for it (in conventional terms of benefits to bodies) at all? It may simply spread of its own accord from chromosome to chromosome, making more copies of itself while other "sedentary" genes cannot. These extra copies may persist, not because they confer advantages upon bodies, but for precisely the opposite reason—because bodies do not notice them. If they have no effect upon bodies, if they are (in this sense) "junk," then what is to stop their spread? They are merely playing Darwin's game, but at the wrong level. We usually think of natural selection as a struggle among bodies to leave more surviving offspring. Here certain genes have found a way, through transposability, or "jumping,"

What your home could have in common with the Met, the Tate, and the Louvre



Claude Gaveau's *Les Mats*, original lithograph. Signed limited edition of 185.



Victor Vasarely's *Fe-Ny*, original serigraph. Signed limited edition of 250.



Ronald Christensen's *Flowerburst*, original serigraph. Signed limited edition of 295.



Franklin S. Galambos' *Soltice*, original hand colored etching. Signed limited edition of 265.



Al Hirchfeld's *Charlie Chaplin II*, original lithograph. Signed limited edition of 200.



Wilbur Streech's *Morning Light*, original serigraph. Signed limited edition of 250.



Sachiko Imai's *Femme de l'Eté*, original lithograph. Signed limited edition of 125.

In your own home, you can exhibit original work by artists who are represented in the world's great museums and galleries.

Artists like Calder. Chagall. Dali. Miró. Picasso. Vasarely.

At the Original Print Collectors Group, we offer moderately priced limited edition prints by these and other well-known artists.

Our offerings include signed original etchings, engravings, and silk-screen prints.

Each print we offer is signed and numbered by the artist. Custom-framed. Accompanied by a certificate of authenticity and a full money-back guarantee.

And each print has been chosen not only for its beauty but for its investment value.

(Works by the artists we offer tend to appreciate, sometimes as much as 30% in a single year. Perhaps that's why *The Wall Street Journal, Business Week, Money,* AP, *Barron's* and UPI have quoted us as an authority on investing in art.)

For more information, send in the coupon. There's no obligation.

You'll find out about the special pleasure of owning original art, instead of just visiting it.



Alexander Calder's *Potpourri*, original lithograph. Signed limited edition of 90.



Antonio Peticov's *Nightfall*, original serigraph. Signed limited edition of 195.

Original print collectors group, Ltd.

215 LEXINGTON AVE., DEPT. NH-34, NEW YORK 10016

PLEASE SEND ME YOUR FREE COLOR CATALOGUE WITHOUT OBLIGATION.

NAME _____
PLEASE PRINT

ADDRESS _____

CITY _____ ST _____ ZIP _____

© 1981 OPCG, LTD

to leave more copies of themselves *within* a body. Is any other explanation required? Orgel and Crick's title reflects this reversed perspective: "Selfish DNA: The Ultimate Parasite."

I can now almost hear the disappointment and anger of some readers: "That bastard Gould. He led us along for pages, and now he gives an explanation that is no explanation at all. It just plain happens, and that's all there is to it. Is this a joke or a counsel of despair?" I beg to differ from this not entirely hypothetical adversary (a composite constructed from several real responses I have received to verbal descriptions of the selfish DNA hypothesis). The explanation seems hokey only in the context of adherence to traditional views that all important features must be adaptations and that bodies are *the* agent of Darwinian processes. The radical content of selfish DNA is not the explanation itself, but the reformulated perspective that must be assimilated before the explanation confers any satisfaction.

If bodies are the only "individuals" that count in evolution, then selfish DNA is unsatisfying because it does nothing for bodies and can only be seen as random with respect to bodies. But why should bodies occupy such a central and privileged position in evolutionary theory? To be sure, selection can only work on discrete individuals with inherited continuity from ancestor to descendant. But are bodies the only kind of legitimate individuals in biology? Might there not be a hierarchy of individuals, with legitimate categories both above and below bodies: genes below, species above. (I confess to what evolutionists call a "preadaptation" for favorable response to the selfish DNA hypothesis. I have long argued that species must be viewed as true evolutionary units and that macroevolutionary trends are often powered by a "species selection" that is analogous to, but not identical with, natural selection acting upon bodies.) Selfish DNA may do nothing for bodies, but bodies are the wrong level of analysis. From a gene's point of view, transposable elements have developed a great Darwinian innovation: they have found a way to make more surviving copies of themselves (by repetition and transposition), and this, in itself, is the evolutionary *summum bonum*. If bodies don't notice this repetition, and therefore cannot suppress it by dying or failing to reproduce, then so much the better for repeating genes.

In this sense, selfish DNA is about the worst possible name for the phenomenon, for it records the very prejudice that the new structure of explanation should be combating: the exclusive focus on bodies as evolutionary agents. When we call repetitive DNA "selfish," we imply that it is acting for itself when it should be doing something else, namely, helping bodies in their evolutionary struggle. Likewise, we should



not refer to repetitive DNA as "nonadaptive," for although it may not be helping bodies, it is acting as its own Darwinian agent. I can't think of a much better term in a language replete with anthropocentric terms, but how about "self-centered DNA"—without the opprobrious overtones that "selfish" inevitably contains.

Another argument against the use of selfish DNA lies in its historical source: Richard Dawkins's book *The Selfish Gene* (1976). Dawkins argued that bodies are the wrong level of evolutionary analysis and that all evolution is nothing but a struggle among genes. Bodies are merely temporary containers for their selfish genes. Superficially, this looks like selfish DNA writ larger, hence Orgel and Crick's decision to borrow the term. In fact, the theories of selfish genes and selfish DNA could not be more different in the structures of explanation that nurture them.

Dawkins writes as a superstrict modern Darwinian, committed to the idea that all features must be interpreted as adaptations and that all of evolution is a struggle for existence among individuals at the lowest level. He merely decided that Darwinians weren't radical enough in reducing such higher-level reveries as "the good of the species" or "the harmony of nature" to the unrestrained struggle of individuals. The struggling items are one level lower—genes rather than bodies—and the Darwinian program of reduction can go even further than modern supporters had dared to hope.

Selfish DNA, on the other hand, gains its rationale from the antireductionistic belief that evolution works on a hierarchy of legitimate levels that cannot be collapsed to the first rung of the scale. Dawkins's selfish genes increase in frequency because they have effects upon bodies, aiding them in their struggle for existence. Selfish DNA increases in frequency for precisely the opposite reason—because it initially has *no effect* on bodies and therefore is not suppressed at this legitimate higher level. Dawkins's theory is an unconventional proposal to explain ordinary adaptation of bodies. Selfish DNA survives only because it makes no difference to bodies.

The idea of selfish genes is, in my opinion, fundamentally incorrect (however stimulating) because the features of bodies that make a difference in natural selection cannot be decomposed into products of individual genes. Each gene contributes to several features and each feature is built by several genes and their complex interactions. When a body survives because natural selection has favored a set of features, selection has touched so many genes in so many complex and unbreakable connections that the idea of individual genes battling for personal survival makes no sense. (See my column of December 1977, but see especially the critique of Dawkins by evolution's grandest old man, Sewall Wright—92 and still going strong—in *Evolution*, vol. 34, 1980, pp. 825–43.) But selfish DNA can spread because it makes no features in bodies. It may be adaptive at its own level, but it is invisible and nonadaptive at the level of natural selection among bodies. Hence it may accumulate at first because natu-

"oooh"

KAHLÚA® & Coffee

Simply, splash a dash of
Kahlúa in your hot coffee.
If you like, add a twist of lemon or lime.

KAHLÚA® & Ice Coffee

Ooh so good with ice coffee too!
And do treat yourself to our Kahlúa recipe book.
Yours for the sending.

Maidstone Wine & Spirits Inc., 116 No. Robertson Blvd., Los Angeles, CA 90048. ©1980 Kahlúa. Coffee Liqueur from Sunny Mexico. 53 Proof.



Our handy knife-rule fits as neatly in your pocket as it fits your needs.

You've never owned anything like this. Not only is it a stainless steel pocket knife that's just 3" long and 3/16" thick when closed—with two blades of fine Sheffield steel. It's also a 6-inch precision rule engraved by Rabone-Chesterman of England, who are known the world over for precision rules. But, the best part of all? You don't have to go any further than your pocket for it.

Send for the Garrett Wade Knife-Rule and our introductory catalog. It's full of fine woodworking tools.

Garrett Wade Co.,
Dept. 19
161 Ave. of the Americas
New York, N.Y. 10013
Please send me _____ pocket knife-rule(s) @ $27.50 p.p.d. plus introductory Garrett Wade Catalog.

☐ Check/Money Order enclosed.
☐ Visa/Master Charge/American Express.

Card No. _____ Expires _____

NAME _____

ADDRESS _____

CITY _____

STATE _____ ZIP _____

ral selection cannot "see" and suppress it.

But if middle-repetitive DNA is self-centered, why does it only exist in hundreds of copies within genomes? If it can spread by transposition while other genes cannot, why does it not generate millions and billions of copies, eventually crowding everything else out? What stops it? Why is it behaving as an "intelligent" parasite (enough copies to be comfortable and powerful, but not enough to destroy the host and itself), rather than as a voracious cancer?

The potential answer to this question, proposed by both sets of authors, illustrates another interesting point about the hierarchical mode of thinking that underlies the theory of self-centered DNA. In hierarchical models, levels are not independent, walled off by impenetrable boundaries from those above and below. Levels leak and interact. Arthur Koestler, whom I do not usually praise but whose commitment to hierarchy I find admirable, chose as his metaphor for hierarchy the double-faced god Janus, standing at one level but looking for connections in both directions.

Now consider different forms of selection working at levels of gene, body, and species. A transposon enters a genetic system and begins to amplify itself by replication and movement. In the process of selection among genes, it is increasing by an analog of what we would call "differential birth" in natural selection among bodies. Its increase initially produces no interaction with the level of natural selection upon bodies, and nothing suppresses its intrinsic drive to manufacture more copies.

But eventually, if its increase continues unabated, bodies must begin to notice. There is an energetic cost attached to the replication, generation after generation, of hundreds or thousands of copies of DNA sequences that do nothing for the bodies investing that energy. Bodies may not notice a few copies, but vast numbers must eventually produce a disadvantage at the good old Darwinian level of natural selection among bodies. At this point, further increases in copies of self-centered DNA will be suppressed because bodies carrying too many copies will suffer in natural selection, taking all their copies with them when they die or fail to reproduce. The usual level of tens to hundreds of copies may well represent a balance between inexorable increase at the level of selection among genes and eventual suppression at the next level of selection among bodies. Levels are connected by complex ties of feedback. My plea for a recognition of levels other than natural selection acting upon bodies is not a negation of Darwinian theory but an attempt to enrich it.

The arguments will continue for a long time. One group of scientists notes the similarity in arrangement within chromosomes of repetitive sequences in two creatures as evolutionarily distant as the toad *Xenopus laevis* and the sea urchin *Strongylocentrotus purpuratus*. This similarity refutes self-centered DNA and points to common function, since wandering transposons, beholden only to their own level, should disperse more randomly among chromosomes. Others point out that an important transposable element in yeast and another in the fruit fly *Drosophila melanogaster* are represented in different strains of the same species by about the same number of copies, but in very different positions among chromosomes. Do the different positions represent self-centered amplification and the similarity in numbers reflect suppression at the higher level of selection upon bodies?

As with all interesting questions in natural history, the solution requires an inquiry about relative frequency, not an absolute yes or no. The logic of self-centered DNA seems sound. The question remains: how important is it? How much repetitive DNA is self-centered DNA? If the answer is "way less than one percent" because conventional selection on bodies almost always overwhelms selection among genes, then self-centered DNA is one more good and plausible idea scorned by nature. If the answer is "lots of it," then we will need a fully articulated hierarchical theory of evolution. My own inclinations are, obviously, for hierarchy. Cartesian reductionism has been the source of science's triumph for 300 years; but I suspect that we have reached its limits in several areas.

We have legitimate, idiosyncratic reasons for continuing our linguistic habit of identifying "individuals" with bodies, and for granting a primacy to bodies among the objects of nature. I can't, for example, imagine any acceptable politics that does not focus upon the primacy of individual bodies—and we weep for the inhumanity of those that did not, but flourished for a time nonetheless. Nature, however, acknowledges many kinds of individuals, both great and small.

Stephen Jay Gould teaches biology, geology, and the history of science at Harvard University.

THIS IS WHAT WE GET FOR NOT FOLLOWING THE CROWD.

A camera with a combination of features you won't find on any other 35mm SLR in its class.

A camera so extraordinary that in just a few short months it has become one of the best-selling in America.

More than a camera. An achievement. The Minolta XG-M.

What kinds of features make a camera this outstanding?

Optical precision for sharp, clear pictures.

Convenience features like automatic exposure to make taking pictures as easy as point, focus, shoot.

Important features like metered manual and exposure override that let you give full rein to your creative instincts.

Electronic features to help prevent mistakes.

Handling features like a built-in, textured grip shaped to fit the curve of your hand.

Even professional features like the optional motor drive that automatically advances the film. One frame at a time. Or at a blistering 3.5 frames per second to capture fast action. Like a touchdown pass rifling into the end zone.

And when you want to unleash your imagination, there are more than 45 Minolta computer-designed interchangeable lenses to help you do it. Along with a full system of accessories.

The Minolta XG-M is only the latest in our over 50-year tradition of creating cameras that are not simply cameras, but outstanding achievements.

See it at your Minolta dealer. To find the XG-M, just follow the crowd.

WAIT 'TIL YOU SEE HOW GOOD YOU CAN BE.



MINOLTA

For more information write Minolta Corporation
101 Williams Drive Ramsey NJ 07446
In Canada Minolta Ontario L4W 1A4

Product appearance and/or specifications are subject to change without notice
© 1981 Minolta Corporation

With a Little Help from My Friends

Many creatures depend on others for protection

by Milton Love

As a young boy, I was short, bookish, and wore incredibly thick glasses—attributes I enjoy to this day. Naturally, I was the prime target of every bully in the neighborhood. In desperation, I searched for a bodyguard, cultivating the friendship of a boy who was, as Arthur Conan Doyle would have remarked, "more accustomed to using his muscles than his wits." Fortunately, I never had to call upon my friend's singular talents, but many organisms regularly depend on others for protection.

Hedgehogs are Old World relatives of moles and shrews. Although fairly small animals, they are infrequently preyed upon, despite their rather charming habit of advertising their sleeping sites with assorted wheezes, snores, and gasps. Certainly one reason for their comparative immunity is their covering of stiff, springy hairs—while another is their ability to use the toxins in toad skins for their own defense.

A number of toads possess glands, lodged just below the skin surface, that secrete a variety of poisons, one of which has the ability to arrest beating hearts (including human). In spite of what might seem ample deterrent, hedgehogs often capture and eat toads with every sign of satisfaction. Before dining, the animals chew on the toad's large, poison-bearing granular glands and take the toad venom into their mouths, where contact with mucous membranes creates frothing. With their tongues, the hedgehogs slather the froth on their spines, apparently as a protective device. Occasionally hedgehogs will rub an entire toad skin over their spines.

In the laboratory, this self-anointing can be stimulated by a variety of substances, including tobacco and sour milk. The behavior seems to be specific to somewhat irritating substances, as hedgehogs eat bullfrogs and mice (which lack toxins) without such ceremony.

Internal retention of toxic substances from prey is another method of adding to one's defensive posture. Carminic acid is a potent defensive compound found in cochineals, small scale insects of the genus *Dactylopius*. Present in blood, muscles, and eggs, the bright red acid is apparently distasteful to such potential predators as ants, which give even dead cochineals wide berth. However, the caterpillar larvae of the moth *Laetilia coccidivora* circumvent and even utilize this chemical barrier. These caterpillars subsist entirely on scale insects and store cochineal remains and carminic acid in the front part of their gut. When disturbed by an ant predator, the caterpillar twists around and deftly deposits a drop of this fluid on its attacker. Moreover, the caterpillar may roll about in this extruded liquid, coating its body, a stunt that seems to deter further harassment.

Many other insects, including grasshoppers and butterflies, feed on plants containing various toxins, storing these in body tissues. For example, glycosides, the powerfully emetic compounds produced by milkweeds (family Asclepiadaceae), are ingested by the larvae and retained in the tissues of adult monarch butterflies (*Danaus plexippus*). Birds attempting to prey on glycoside-containing monarchs quickly develop a strong aversion toward their prey. However, some recent evidence indicates that not all monarchs in a population contain enough glycosides to produce an emetic response. Moreover, it appears that some birds can distinguish emetic and nonemetic individuals. On Mexican overwintering grounds, orioles and grosbeaks were observed capturing and releasing some monarchs while ingesting others. The birds were also selective as to what body parts were eaten. Abdominal and thoracic regions were favored, while wings (known to have high glycoside concentrations) were discarded. Apparently, some predators are not only able to distinguish (by taste) nontoxic monarchs but can also select the least distasteful parts of the prey.

The defensive system of the brightly colored sea slug *Flabellinopsis iodinea* is artfully appropriated from its food source, the hydroid *Eudendrium ramosum,* which possesses numerous stinging cells called nematocysts. Nematocysts contain a coiled, whiplike structure that is suffused with toxin and often lined with barbs. When the cell is triggered by mechanical or chemical stimulus, the whip lashes out, impaling the nearest tissue. Although nematocysts vary in potency, some, such as those of the Portuguese man-of-war and various Cubomedusae can kill large organisms including humans. The sea slug ingests and stores the cells in cerata—elongated tubes extending from its back.

F. iodinea feeds by grasping a hydroid in its jaws and rasping off pieces with its toothlike radula. The food material, containing nematocysts, is funneled through a buccal (mouth) cavity and esophagus lined with a tough collagen material that seems to protect the underlying tissues from any discharged nematocysts. Churning action of the sea slug's stomach separates the nematocysts' triggers from the stinging cells. From the stomach, the otherwise intact cells flow into a digestive gland that has connections to each cerata via cilia-lined canals. The nematocysts travel up these canals to cerata tips, where they are housed. The whole process, from hydroid to cerata, is rapid, taking as little as twenty minutes to complete. There are no known predators upon *F. iodinea,* for which this defensive maneuver may

Q. What is the new WEBSTER'S DELUXE UNABRIDGED DICTIONARY about?



A. It's about 2,300 pages and more than 4 inches thick!

Plus it contains these important supplements!

1. A Dictionary of Biography
2. A Dictionary of Geography
3. A Dictionary of Noted Names in Fiction, Mythology, Legend
4. A Dictionary of Foreign Words and Phrases
5. A Dictionary of Scripture Proper Names and Foreign Words
6. Abbreviations Commonly Used in Writing and Printing
7. Practical Business Mathematics
8. Forms of Address
9. Tables of Weights and Measures
10. Special Signs and Symbols
11. Presidents of the United States
12. Vice Presidents and Cabinet Officers of the United States
13. Declaration of Independence
14. Constitution of the United States
15. History of Canada
16. Charter of the United Nations
17. Air Distances between Principal Cities
18. Principal Geographic Features of the World
19. Commercial and Financial Terms

For more than 40 years Webster's Unabridged Dictionary has served as an invaluable reference for students, teachers, businessmen, secretaries ... and workers in all trades and professions. The reason is simple. Here is a dictionary that fills the need for accurate and full definitions, correct spellings and pronunciations, full etymologies, synonyms, as well as other general and specific information.

A large staff of lexicographers and linguists has painstakingly edited and updated each definition so that it is clear, accurate, and readily understood in all its senses. Many new entries have been added, including recent additions to the language in the natural and social sciences, the humanities and other specialized branches of human knowledge.

un·à bridged′, *a.* not shortened; complete; specifically, designating a dictionary that has not been abridged from a larger work.
un·ac·cent′ed, *a.* not accented; specifically, in

The large, clear, legible type shown above (actual size) "makes this unabridged dictionary the most readable one in print."

THE BARNES & NOBLE MAIL ORDER GUARANTEE

Every book you purchase from Barnes & Noble by mail must meet your standards. If not ... return it for a full refund within 30 days or credit to your charge account.

In business for 105 years, Barnes & Noble has become "the world's largest bookstore." (See the current Guinness Book of World Records.) Our goal is to sell the finest books in the world at the lowest possible prices. Ask about us at your local school or public library.

. . . now own one of the finest reference books in the world at less than ⅓ of its original price.

DELUXE COLOR EDITION

Includes Thousands of Illustrations Along With a Complete Collection of Full-Color Maps of the World

BARNES & NOBLE, 126 FIFTH AVE., N.Y.C. 10011

Offer good only in the continental U.S.A.

SAVE $50 *PUBLISHED AT $69.95 NOW ONLY $19.95*

BARNES/SALE & NOBLE/ANNEX

MAIL ORDER DEPT. WD 552A 2627F
126 FIFTH AVE., N.Y.C. 10011

Please rush me _____ *Webster's Deluxe Unabridged Dictionary* at your special sale price of $19.95 (plus $3.00 postage and handling). *N.Y. and N.J. Residents: Please add sales tax.*

☐ C

Mr Ms
NAME (Please Print Clearly)

ADDRESS

CITY ZIP

I prefer to charge this purchase: ✓Check One

American Express Card ☐ VISA ☐ MasterCard ☐ 4 digits above your name

Account# Exp.

Signature

FOR FASTER SERVICE

CREDIT CARD CUSTOMERS
CALL TOLL FREE 1-800-228-2057 / EXT. 15
Lines are open 24 HOURS
7 DAYS A WEEK including Sundays
In Nebraska call 402 571-4900

© 1981, Barnes & Noble Bookstores, Inc.



Two cool characters. $95 each.

Steuben's collection of seven Hand Coolers includes the Turtle and Frog. In smooth, polished crystal, they feel cool and soothing in the palm of your hand. Or they can control papers on your desk. 5514e Turtle: length, 2½". 5510e Frog: length, 2¼". $95 each. Signed Steuben. You may order by phone: 212-752-1441. Out of State: 800-223-1234. Or write Steuben Glass, Fifth Avenue at 56th Street, New York, N.Y. 10022. Major credit cards accepted.

STEUBEN GLASS

The Rubáiyát of Omar Khayyám

This is a complete recording, delivered by Louis Zoul, of Edward Fitzgerald's 5th version, and is the cumulative effort of three men of genius.

It is followed by a few comments and comparisons, and also Pedro Calderon de la Barca's The Dream Called Life and Life is a Dream.

Lastly, beginning with Hamlet's soliloquy, there is some of Shakespear's best.

Among the kudos we've received, this came from a professor in Ethiopia: "It is beyond compare!" A Brooklyn lady wrote: "I play it over and over. It is my treasure." While from Canada a gentleman requested: "Because the record is such a beauty, send another one."

A superlative delivery of superlative poetry

$10.00

Now there is also available a companion book. It is hand bound and printed on high bulk long life archive book paper. Estimated duration 500 yrs.

$15.00

Plus Applicable Sales Tax
(only for N.Y. State residents)

Available Only By Mail

PUBLIC OPINION
Box N-4044 Long Island City,
New York 11104



Monuments of Time

The Kawai piano is perfection obtained by the hand of time. Your investment in Kawai enhances with time.

Kawai America Corporation

24200 So. Vermont Ave., Harbor City, Calif. 90710

KAWAI

be at least partly responsible. Even *Navanax inermis,* a marine sluglike form known to prey upon many sea slug species, will actively avoid the trail laid down by *F. iodinea.*

I am the first to admit that these defending organisms (toads, cochineals, and hydroids) are less than willing participants in our little dramas. There are, however, numerous animals that assume the role of defenders of the faith with somewhat more grace.

One can, for instance, employ a bodyguard on a sort of retainer basis, as does the caterpillar larva of *Glaucopsyche lygdamus,* a small butterfly of the western United States. Incapable of mounting a credible deterrent force of its own, the tiny larva uses food to co-opt ants of the genus *Formica.* Throughout much of its life, this caterpillar is surrounded by these ants, which groom and palpate its body and feed on sugar water produced by a gland (Newcomer's organ) situated on the caterpillar's seventh abdominal segment.

The ants are the caterpillar's major protection against tachinid flies and braconid wasps, two parasitoid predators. Parasitoids are parasites as larvae but are free living as adults. The flies and wasps inject their eggs into the caterpillars, where the young grow until the caterpillars pupate, after which the parasitoids emerge, killing their temporary hosts. Ants actively attack these predatory flies and wasps, squirting an irritating liquid at them as they approach their intended victims. Removal of the ants from plants harboring caterpillars leads to a substantial reduction of the caterpillar population.

Some speculate that the ants are being shortchanged in this business arrangement, that the food value of *G. lygdamus* secretions is limited. If so, the caterpillars are no doubt mimicking the food materials of other species the ants defend, such as various plants and aphids that supply high-quality food in exchange. By capitalizing on well-established habits of these ants, the caterpillars may be receiving maximum benefits with only small expenditures. Where is Samuel Gompers when ants really need him?

Sea anemones of the genus *Calliactis* are usually found on shells occupied by hermit crabs. In at least some instances, *Calliactis* affords the crabs considerable protection from octopuses, the crabs' major predator. Octopuses prey on an unprotected hermit crab by enveloping its shell and continuously pulling on the crab until it weakens (a process that

may take days). However, the presence of *Calliactis* forms a powerful argument against such attacks. In aquarium experiments, an octopus that attacks a guarded shell will retreat very quickly, as if hurt. After a few such incidents, all attacks cease and, in fact, the octopus will retreat whenever a protected crab approaches.

The relationships between various species of *Calliactis* and hermit crabs are complex. In some cases, the anemone decides when to transfer to a hermit crab shell, moving with some alacrity from site to site. In other situations the crab has some influence, going so far as to assist in removing an anemone from one substrate and settling it on its own shell. Such is the value of an anemone that some species of hermits steal anemones from other species.

The polychaete worm *Arctonoë vittata* lives within the folds of the fleshy mantle of the marine intertidal keyhole limpet *Diodora aspera*. Though normally reclusive, the worm boarder will actively defend its mollusk host against starfish predators.

Sensing a starfish, the limpet thrashes about with considerable verve, in what is known as a mantle response. Soon thereafter—often within fifteen seconds—the worm sticks its head out from under the shell and searches about with poking movements. As it comes close to the predator, the worm's movements quicken until it touches one of the many small tube feet located on the starfish's underside. Once contact is made, the worm examines the foot with sensory palps located on each side of its head. Then it thrusts out its jaws and bites the tube foot, often repeatedly. Apparently, this is usually sufficient to cause a starfish to withdraw those feet that are in the limpet's vicinity. Scientists do not know what stimulates the worm to come to the limpet's rescue. Chemical cues emitted by host, predator, or both may be involved or the movement of the mantle may be the primary stimulus.

The world being what it is, there will be those among us who will insist on a somewhat mechanistic view of this behavior, seeing only that *A. vittata* has evolved through natural selection to defend its (limpet) territory. Ever the romantic, however, I prefer to see an embattled defender of hearth and home, where home is another organism.

Greater love hath no worm.

Milton Love is a research associate in the Department of Biology at Occidental College, Los Angeles.



Ralph Hoffmann: Unsung Guide to the Birds

Early bird guides concentrated on birds in the hand; a New England schoolmaster produced the first for birds in the bush

by Harold Swanton

Elliott Coues was not one to mince words. "The double-barrelled shotgun," he wrote in his 1874 *Manual of Field Ornithology*,

> is your main reliance. Under some circumstances you may trap or snare birds, catch them with bird-lime, or use other devices, but such cases are exceptions to the rule that you will *shoot* birds, and for this purpose no weapon compares with the one just mentioned.

His *Manual* took the student through the various disciplines to be mastered by the bird lover: choosing ammunition; cleaning and loading weapons; learning the types and traits of hunting dogs; approaching, killing, and recovering birds; killing wounded birds; handling bleeding birds, mutilations, bloodstains, decomposition, and more.

In his *Birds of the Northwest*, also published in 1874, Coues detailed an encounter with the solitary sandpiper:

> Once, coming up to a fence that went past a little pool, I saw eight tattlers of this species wading about in the shallow water, searching for food. I pulled trigger on one; the others set up a simultaneous outcry, and I expected them to fly off, but they presently quieted down and began feeding again. Without moving from my place, I fired three times more, killing a single bird at each discharge; still no effect upon the survivors. Then I climbed the fence and stood in full view of the four remaining birds; they merely flapped to the further side of the pool and stood looking at me, nodding away, as if agreed that the whole thing was very singular. I stood and deliberately loaded and fired three times more, taking one bird each time; and it was only as I was ramming another charge that the sole survivor concluded to make off.

One might wonder if this is how the solitary sandpiper got its name.

Blood lust, however, was not what sent Coues and his colleagues into the field with weapons at the ready. Great numbers of birds in the hand were required to provide the data they were compiling on size variation, molts, and feeding habits, for example. Identification alone often demanded a corpse; only in recent years have sight records been given any credence. The dim, low-power field glasses of Coues's day were simply not up to fixing on a darting warbler in a tangle of branches and determining the number of wing bars.



Ralph Hoffmann, armed and ready

Eleanor Hoffmann

SLIDE SHOW.

This Christmas get an entirely new view in slide projection. Our exclusive Slide-Scan™ built-in screen puts viewing slides right at your fingertips. Just remove the standard lens, pull out the Slide-Scan screen, and you're ready to preview, review, or just plain view your slides ... anywhere ... without putting up a projection screen!

Other new features include a conveniently located, illuminated control panel. Much longer lamp life (70 hours). And, on some models, a variable-speed auto-timer.

These new Carousel projectors make a terrific gift for anyone who has a 35 mm camera. Because they give you a more uniform corner-to-center illumination. A manual select control, which lets you remove the tray when the power is off. And a rapid, reliable, automatic focus system on the top four models.



Add all this to regular features like dependable gravity feed, an Ektanar C projection lens, and a dark-screen shutter latch. Plus accessories such as a dissolve control and a sound-slide synchronizer. Then you'll know why the new Kodak Carousel projector makes such a great gift.

***KODAK CAROUSEL*® PROJECTORS. THE NEW BREED.**

SIDE SHOW.



THIS CHRISTMAS KODAK INTRODUCES THE NEW BREED OF PROJECTORS THAT GIVES YOU BOTH.

© Eastman Kodak Company, 1981

Until the eight-power, high-illumination prism binocular became available after the turn of the century, the serious bird student had to take John Burroughs's advice: "Don't ogle it through a glass! *Shoot* it!" Amateurs and professionals alike shot birds and took them home to check tibia length and bill color, axillars, secondaries, and undertail coverts against descriptions in the works of Robert Ridgway, Thomas Nuttall, or Coues. Books of the nineteenth century document habits, mannerisms, migration dates, and particularly nests and eggs (oology was one of the passions of the day) in great detail, but field marks were mentioned sketchily if at all. There was little point in describing flight patterns and call notes when more often than not the reader would have the bird in hand. Sophisticated field identification points—nuances in color, feather edging, and subtle differences in call notes and songs that today enable a good field birder to identify confusing species—were either unknown or simply unmentioned in the literature. Although engravings would have been adequate to illustrate important field marks, color printing was nonexistent and, aside from Audubon, there were few fine bird artists until Louis Agassiz Fuertes came along toward the end of the century. For all these reasons, the idea of a field guide that would deal exclusively with sight identification developed slowly.

Forty years before Coues's *Manual* appeared, for example, Nuttall, one of the founding fathers of American ornithology, provided a description of the solitary sandpiper that is of little use to an observer in the field.

> Upper parts brownish olive, spotted and streaked with white; wings and tail dusky, outer tail feathers white with dark bars; underparts white, breast and sides with dark markings. In the winter the plumage of the upper parts is dark ash, and the markings are less distinct.

The barred outer tail feathers, an important field mark, are mentioned but not emphasized. Nuttall grouped the solitary with the green sandpiper of Europe, although they are different species distinguishable in the field; he also made no attempt to separate the solitary from such similar birds as the spotted sandpiper and the lesser yellowlegs. The engraving accompanying the essay is of little help. Following the description is a page and a half of text dealing with nest and eggs, idiosyncrasies, and feeding habits.

Frank M. Chapman's *Handbook of Birds of Eastern North America* appeared in 1895 and remained a standard reference work for three decades. Published in a pocket-size format, the book provided detailed descriptions and syllabicated call notes in some species, but it was still really more for the bird in the hand than in the bush. Chapman evidently recognized its shortcomings. In the preface to his 1903 *Color Key to North American Birds*, illustrated by Chester A. Reed, he wrote:

> To learn to call a bird by its right name is the first step in the study of ornithology. . . . From the scientific point of view there is but one satisfactory way to identify a bird. A specimen of it should be in hand . . . [but] we cannot place a gun in the hands of these thousands of bird lovers whom we are yearly developing.

In some respects, however, Chapman's laudable objective of simplifying things added to the confusion. Perching birds, for example, were grouped, not by relationship, but by color: the meadowlark is cheek by jowl with the evening grosbeak, the yellow-headed blackbird with assorted warblers. The colors superimposed on engraved sketches were not entirely successful; descriptions were short and telegraphic.

Florence Merriam Bailey's 1902 *Handbook of Birds of the Western United States* was another turn of the

IT'S A PERFECT TIME TO INVEST IN GOLD



SOLID 24KT. GOLD INGOT SWISS WATCH

Now, own pure gold and a magnificently fashionable time-piece. One you can wear with confidence, pride and pleasure. The face—an authentic 24 Kt. Solid Gold Ingot—.999 pure! Solid Gold. Solid luxury. Solid evidence of your excellent taste . . . and excellent investment wisdom. Behind that splendid Solid 24 Kt. Gold Ingot face is a masterfully crafted 17-jewel Swiss timepiece . . . with a superb jewel stem and genuine leather band. Reliable. Dependable. The precision Swiss movement leaves nothing to be desired. It's shock protected, and guaranteed for one year. Unquestionably, a watch of unique splendor. The most memorable gift you can give. What man or woman will ever forget receiving their own superlative 24 Kt. Solid Gold Ingot Swiss watch . . . a watch to cherish for a lifetime. And what about you? Wouldn't you relish seeing one gleam and glint on your own wrist?

*Watches available at this price are limited. Therefore, you are urged to order today to take advantage of this current price. Due to the daily changing market price of gold, orders are subject to acceptance and may be declined.

OFFICIAL ORDER FORM – ORDER BY NOVEMBER 30, 1981

COLUMBIA MINTERS 905 Sixteenth Street N.W., Washington, D.C. 20006 **W162**

Please send me the following 24KT Gold Ingot Watches under your 14-day money back guarantee

___**1-gram***24KT Gold Ingot Watch at $199 each
_____men's style _____women's style
___**5-gram** 24KT Gold Ingot Watch at $369 each
_____men's style _____women's style
___**10-gram** 24KT Gold Ingot Watch at $549 each
_____men's style _____women's style

I am enclosing my remittance for $_____ (which includes $5 insurance and handling for each watch ordered) **or**

Charge $_____to my
☐ Diners Club ☐ American Express

Card# _____ Exp.____

Signature _____
(Charge orders must be signed to be valid)

Name _____

Address _____

City, State, Zip _____

For faster service, credit card charge orders may call FREE — 24 hours a day.
800-228-5000

©Columbia Minters 1981

century effort to help the novice. Following a description of each bird—including information on distribution, nests, and measurements—Bailey often gave some key field marks, although sketchily. For example, she included the important barred outer tail feathers in her list of the characters of the solitary sandpiper, but she failed to point them out where it really matters, that is, in comparisons with similar species. All she said in this regard is that "the solitary is distinguished from the other sandpipers in the field by its dark color and black wings, and by its shrill note as it takes wing."

One welcome aspect of Bailey's book is the occasional short paragraph giving additional information on habitat and behavior. Solitary sandpipers are said to be "quiet, shy birds, but not unapproachable, and they show an interested curiosity in strangers." The handbook has 33 plates by Fuertes, not specifically geared for field identification, and more than 600 cuts in the text, although many of the latter are tiny photographs of study skins, not renderings of live birds.

Two years later, with the publication of *A Guide to the Birds of New England and Eastern New York*, the first true field guide arrived. The author was Ralph Hoffmann, a young schoolmaster and Latin scholar with an eye for field marks, an ear for songs and call notes, a writer's gift for setting them down, and an amateur's joy in his task. While others had recognized the need for books addressed to the growing numbers of amateurs interested in the study of birds, Hoffmann was the first to concentrate on field identification alone. In his preface to *Birds of New England*, he took the reader by the hand:

> The study of birds presents plenty of difficulties, which add fuel to the flame of real enthusiasm; there are sloughs of despond beyond which the faint-hearted never get. A guide who knows the way, its pitfalls and short cuts, is always welcome . . . when our only weapon is the opera-glass.

The *Guide* had four black-and-white wash drawings by Fuertes and 95 cuts, generally good sketches illustrating diagnostic field marks. The text paid unprecedented attention to behavior, habitat, and above all, call notes and songs. Hoffmann seems to have been among the first to recognize that the sounds birds make are essential to the identification of many species in the field. In many cases, he syllabicated them expertly with a refined phonetic system, both here and, to an even greater extent, in his *Birds of the Pacific States*, which appeared in 1927.

One last look at the solitary sandpiper, this time through Hoffmann's eyes:

> *Ad. in spring.*—Upper parts olive-brown, sparsely speckled with white; front of neck streaked with dusky; outer *tail-feathers white, barred with black*; wing not showing a row of white spots in flight. *Ad. in fall.*—Upper parts dark ashy, even less speckled with white; front of neck less streaked with dusky. *Im.*—Upper parts brownish-gray, everywhere speckled with white; sides of head and neck dusky; rest of under parts white; tail as in adult; legs greenish.

Note his points of emphasis in the abbreviated description—the barred tail feather field mark is italicized (and illustrated in an accompanying sketch) and the unmarked wing pointed out. Furthermore, in comments following the description, Hoffmann compares the solitary sandpiper's call notes, wing markings, and flight with those of similar species, along with evidence to be gained from habitat. Everything in the profile is aimed at identification in the field. As he explained in the introduction,

> There has been no attempt to give a com-

FREE FULL COLOR CATALOG OF DISTINCTIVE BRITISH POST OFFICE PHILATELIC SPECIALTIES



Reserve now for your free copy of the new *1982 British Collection* catalog. This twelve-page, full color catalog offers a breathtaking array of First Day Covers, Postal Cards, commemoratives, definitives, and Year Pack collections. There's even a wide range of unique specialty items containing postage stamps which are not readily available.

The British Collection catalog is a visual treat, perfect to begin a collection, add to one, or as a gift selector. It's yours free when you complete and mail the coupon below.

SPECIAL OFFER

Official British Post Office Miniature Sheet Set
The 1981 Christmas Series Philatelic Pack*
*To be issued November 18, 1981

This special advance offering is to introduce you to the craftsmanship and quality of the items in *The British Collection*.

Handsome Miniature Sheet Set. Includes the already scarce 1978 "British Architecture" Sheet, and the desirable 1979 "Sir Rowland Hill" and 1980 "London '80 International Stamp Exhibition" Sheets. This set contains the *only three Miniature Sheets ever issued* by the British Post Office.

Christmas Series Philatelic Pack. Among all the holiday stamp commemoratives issued worldwide, British Christmas issues are often considered the most popular and exciting. Includes the Presentation Pack of stamps, First Day Cover and Postal Cards of what's sure to be a sought-after issue.

☐ Yes, send my FREE copy of *The British Collection* catalog. (Shipment begins Jan. 1, 1982.) CC3NH

☐ I also wish to order the following and receive an advance copy of the catalog.

QUAN.	ITEM	PRICE
	Official Miniature Sheet Set(s), at $12.95 per set	
	1981 Christmas Series Philatelic Pack(s) at $9.95 per pack	
	NYS residents add sales tax	
	Postage and handling	1.50
	TOTAL	

☐ Check or money order payable to Stanley Gibbons, Inc. enclosed (no cash, please)
☐ MasterCard ☐ VISA ☐ American Express
Acct #_____
Exp. Date_____
Signature_____
Allow 4-6 weeks for product delivery

Name (please print)_____
Address_____
City_____ State_____ Zip_____

THE BRITISH COLLECTION
BY STANLEY GIBBONS
P.O. Box S, Carle Place, N.Y. 11514

ASIA: *Traditions and Treasures*

A Rare Offer to Members of the American Museum of Natural History



A MAGNIFICENT BOOK

For the first time, the Asian treasures in the vast collections of the American Museum of Natural History are unveiled in a majestic hard-covered volume: *Asia: Traditions and Treasures* by Walter A. Fairservis, Jr., with color photographs by Lee Boltin. Asia—the mother of civilization—has fascinated the West for centuries. For the past 112 years, the Museum has assembled the greatest collection of Asian art, archeology, and ethnology in the Western Hemisphere. Part of the collection is now on display in the stunning new Gardner D. Stout Hall of Asian Peoples at the American Museum.







ASIAN TREASURES IN FULL COLOR

The large-format book contains 96 superb full-color photographs of priceless Asian treasures: translucent jades, delicate ivories, silks and wrought brasses, worked gold and silver, richly woven rugs, statues of terrifying Buddhist demons, painted silk tapestries, and much, much more.

RARE ARCHIVAL PHOTOGRAPHS

Asia: Traditions and Treasures is enriched with more than 100 fascinating nineteenth and early twentieth century photographs from the Museum's archives, most never before published. These intimate pictures of people, street scenes, cities, and landscapes are an invaluable glimpse of traditional Asia—now lost forever.

A JOURNEY OF DISCOVERY

In evocative prose, Dr. Fairservis sweeps the reader across Asia, focusing on the masses of people and the so important land bridges between Asian countries. He weaves together the human story, from dwellers in the earliest villages of civilization to rugged Siberia nomads to powerful emperors ruling vast domains from the cente of the world. The book is a love affair between a man and a cont nent. The author longs to return to Asia, and you will, too, aft you experience *Asia: Traditions and Treasures*.

A LANDMARK PUBLICATION

Asia: Traditions and Treasures is a landmark publication of tl American Museum. It celebrates the creation of the Hall of Asi Peoples, the largest exhibition of its kind in the West. The M seum and Harry N. Abrams, Inc., publishers of fine art books, ha jointly produced the book. It has been printed and bound with ca by Asian craftsmen.

Yes, I would like to order__volume(s) of *Asia: Traditions and Treasures*. I understand that the book will be sent to me with a bill at the special discount price of $39.95 plus $2 for shipping and handling per book. If I am not satisfied, I may return my volume within ten days for a full refund or credit. This offer is valid only until December 31, 1981 and is open only to Members of the American Museum of Natural History.

☐ Bill me. ☐ Payment enclosed (in an envelope, please).

Name

Address

City State Zip

Signature

Membership category Associate Participating Donor Elected

Please mail before December 31, 1981

No Postage
Necessary
If Mailed
in the
United States

BUSINESS REPLY CARD

First Class Permit No. 2984 New York, N.Y.

ASIA:
Traditions and Treasures
American Museum of Natural History
Central Park West at 79th Street
New York, N.Y. 10024



A Special Offer for Members

Asia: Traditions and Treasures will sell in fine arts bookstores for $50.00. However, the Museum is offering its Members an opportunity to purchase this book for only $39.95 until December 31, 1981. This large, 20% savings is available *only* to Members of the American Museum and *only* until December 31, 1981. So please place your order soon with the attached postage-free reply card. We will mail your volume to you for a free 10-day examination. If it does not meet your expectations, simply return it to the Museum for a full refund.

THE AUTHOR Archeologist Walter A. Fairservis, Jr., could have been a model for the hero of *Raiders of the Lost Ark*. More than three decades ago, he journeyed through Japan and dangerous areas of China as an Army intelligence officer. Since then, he has led many expeditions into remote archeological sites in Asia. He also teaches at Vassar College. Dr. Fairservis was the scientific consultant for the Museum's new Hall of Asian Peoples. The depth of his knowledge and love of Asia permeates this readable book.

THE PHOTOGRAPHER Lee Boltin is famous for such fine art photography as his pictures in the best-selling catalog and posters for the King Tut show. But few of his admirers realize that Boltin learned his craft at the American Museum of Natural History during the decade following World War II. His return to the Museum to photograph the priceless objects from the Asian collection was a labor of love, and the lovely color photographs in this book show it.



HE WAS never elected. But every night "Mayor" Orlo McBain is the last man to walk the streets of Culross, Scotland. He checks a knob, closes a gate and goes his way. The good things in life stay that way.

Preferred for smoothness, Dewar's® never varies.



Authentic.
The Dewar Highlander

BLENDED SCOTCH WHISKY · 86.8 PROOF · © 1981 SCHENLEY IMPORTS CO., N.Y., N.Y.

plete description . . . nor does the book contain anything like full biographies of each species. . . . Full accounts of the lives of the birds are to be found in many excellent books . . . which may be used to supplement this Guide.

Hoffmann's recognition of the importance of field observations grew out of a boyhood of birding. Born in Stockbridge, Massachusetts, in 1870, he was such an expert birder as a boy that when the English poet Matthew Arnold came to town and wanted the best bird watcher available to take him walking in the Berkshires, the townfolk summoned thirteen-year-old Ralph.

Hoffmann graduated from Harvard at twenty, married at twenty-three, and spent most of his life as a teacher, not a scientist. Not until the last decade of his life, when he was summoned to the directorship of the Santa Barbara Museum of Natural History, did he leave schoolteaching.

He had no formal training in ornithology or botany, and although he became an expert in both fields, he retained his amateur status. As a Latin teacher, he would have been pleased to point out the root of the word *amateur—amator*, Latin for "lover." Hoffmann brought an amateur's excitement and joy to his work, reflected in every line he wrote.

He came to the classics naturally: his father, Ferdinand Hoffmann, was a distinguished Latin and Greek scholar who ran a boys' boarding school in Stockbridge. While working on *Birds of New England*, Ralph supported his wife and three children by teaching Latin at Brown and Nichols School in Cambridge. In 1909 an offer came for the headmastership of the Country Day School for Boys in Kansas City. Under his direction the school grew from a gathering of eighteen boys in an old country homestead into a preparatory school with eighty-five students.

In 1919, Hoffmann accepted a post at the Cate School for Boys in Santa Barbara. The flora and fauna of California were terra incognita and an exciting challenge. He responded by beginning, almost immediately, the research that culminated eight years later in *Birds of the Pacific States*.

His diaries chronicle progress on the project from the start on April 3, 1921—"Started notes for Cal guide"—to the finish on June 2, 1927—"G. [Gertrude, his wife] brought a copy of The Book home from town." Hoffmann comes alive in the entries between. Bird notes appear throughout: the first pileolated (Wilson's) warbler of the spring;

If you like the outdoors, you'll love canoe

Since 1973, America's only canoeing and kayaking magazine.

THINK canoeing all year long. Join us in armchair cruising, whitewater thrills, expeditions, racing, sailing and special events ...all in 6 big, colorful issues each year.

EXPLORE rivers, lakes, tidal waters with maps, pictures and detailed articles by the greatest group of writers, photographers and outdoor experts in the paddling world.

LEARN where to go for the best canoeing...where to camp, what to pack, what's new...plus how-to articles and our famous annual Canoe/Kayak Buyers Guide supplement.



JOIN thousands of outdoor adventurers whose meeting place is **canoe** magazine. Get your special one-year subscription now for only $8.95.

SAVE $3.05 over the regular price. Send no money. We'll bill you later. Mail the coupon below or, for Fast 24-hour order service, call our Toll Free Number:

1-800-331-1750
Ask for Operator 23

canoe 1204 West Main St. Fort Wayne, IN 46808
One-year subscription $8.95 Canada and Foreign $11.95

NAME _____

ADDRESS _____

CITY/STATE/ZIP _____

Richard Leakey reveals the latest answers to our oldest questions.

Called "the organizing genius of modern paleoanthropology" by Harvard's David Pilbeam, Richard Leakey takes us across seven continents, from the fossil beds of East Africa to the caves of Peking Man, and through millions of years of human history to unearth the latest clues in the story of what made us the way we are today.

"No one is better equipped for the task. Well written and beautifully illustrated."—DESMOND MORRIS, author of *The Naked Ape*



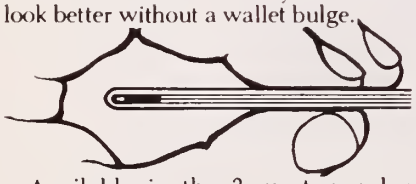
Literary Guild Selection
Oversize format, illustrated with over 100 color photographs, plus maps and charts.
$24.95 at booksellers

DUTTON
2 Park Avenue, New York, N.Y. 10016

The Making of Mankind
Richard E. Leakey

Thinner Wallets

Until recently the thinnest wallets were made from expensive seal skins. Then a new material was developed—Oxford Nylon. Pin Craft Corporation patented a unique line of wallets out of this durable woven material. Consumers' Research Magazine did an extensive study on wallets and concluded by giving their top recommendation to Oxford Nylon wallets. Oxford Nylon does not have the thickness of leather, yet it is more durable, lighter, longer wearing, flexible and very thin. Thus the Oxford Nylon wallet is more comfortable to wear, and your clothes look better without a wallet bulge.



Available in the 3 most popular styles, all have window cases for 16 or more credit cards. You can try an Oxford Nylon wallet with the understanding it can be returned within 31 days for full refund. The wallets are sold regularly (since 1973) through the Wall Street Journal. Three year guarantee. Great gifts for friends and associates. Give yourself a 10% discount when ordering 3 or more. Send the coupon or equivalent information to:

Pin Craft Corporation Dept. NH6
16 N. Mentor Ave., Pasadena, CA 91106

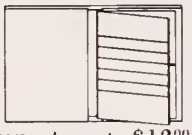
Sportster — Smallest and thinnest. A card-case and billfold, for hip or shirt pocket. $7.00



Classic–Thinnest hip pocket wallet with a section for money and notes plus two hidden compartments. $10.00



Executive—Coat or hip wallet with a handy stacking rack for credit cards and a 3½x5 picture window. Two hidden compartments. $12.00



Put the model letter **S, C,** or **E,** and quantity after the color(s) you want:

Black_____ Brown_____ Tan____
Burgundy_____ Dark Green_____
Navy Blue_____. Add $2.40 for embroidered initials_____ in gold ☐ or silver ☐ gift wrap ☐. Made in U.S.A.

Name (Print) _____
Address _____
_____ Zip_____
Check ☐ M.O. ☐ MasterCharge ☐ Visa ☐
Carte Blanche ☐ Diners ☐ Expires____
Card # _____

To speed credit card orders, call toll free nationwide (800) 423-4541. In Calif., AK, HI, toll call (213) 793-2101.

condors in Sespe Gorge; nesting petrels on the Channel Islands off the Santa Barbara coast. He also reports on tennis matches (he played with John Galsworthy and beat him 6–4, 1–6, 6–4) and planting dates for vegetables, as well as some head-butting with William Leon Dawson, author of *Birds of California.* There were field trips in his open Ford to Sequoia and Yosemite national parks, to Arizona, and to the wilderness of Modoc County, where he first heard reports of the disastrous earthquake that hit Santa Barbara in 1925. Writing about one of his desert expeditions, Hoffmann noted:

> I had better luck with my car than I deserved. I camped out one night in the desert and in the morning found I had a flat tire. My spare was also soft. I took out my pump and found a nut was missing and the handle wouldn't stay on. I started to walk to the nearest station to get my pump repaired. The first car I met was run by a sewing machine agent . . . who had two hundred nuts of every size and description, one of which fitted my pump. Considering the fact that I had gone on a desert trip without looking to see that my pump was in order, we might say that there were two hundred and one nuts represented.

The appearance of *Birds of the Pacific States* in 1927 brought cheers from the birding world and huzzahs from academe. Florence Merriam Bailey put her finger on the quality that to this day remains the book's greatest strength: "Your field introductions—putting your bird in its setting, as Mr. [John] Burroughs said—are delightful, admirable, a real pleasure to an old field worker."

© 1927, 1955, Houghton Mifflin Co.



Solitary sandpiper from Hoffmann's Birds of the Pacific States

To assert as some old-time birders do that Hoffmann's *Birds of the Pacific States* is the finest American field guide ever written may be to overstate the case. What is unarguable, however, is Hoffmann's ability to forecast with near prescience the exact circumstances—region, habitat, season, feeding behavior, call notes, song, idiosyncrasies—under which birders are apt to encounter each of the subjects they profile. Always the teacher, he takes us by the hand to the edge of a marsh, to a streamside willow thicket or an alpine meadow, picks out his bird, brings it into focus, and tells us what to look and listen for. Nobody before or since has done this quite as well. In this respect, *Birds of the Pacific States* is a classic.

With the publication of his guide in 1927, Hoffmann had five years remaining to him before his tragic, but somehow fitting, death. The *Birds* behind him, he was now absorbed in botany, particularly the buckwheats. He had made frequent trips to the Channel Islands in search of them, and when the opportunity came to go to San Miguel Island on July 21, 1932, he enthusiastically took it. Arriving at the island, Hoffmann decided to collect some buckwheat specimens growing on a nearby cliff before joining his companions. He never appeared. A search was begun in heavy fog, and eight hours later, some time after nightfall, his crumpled body was found at the foot of an almost perpendicular cliff. He had evidently tried to climb after his buckwheat specimen, using his trowel for support, and the handle had snapped off. It was found beside the body.

Hoffmann is remembered today in Santa Barbara, particularly by those connected with the museum. A plaque in the Hoffmann Loggia memorializes him as "a student of flowers and birds who welcomed the children and made the museum a center of inspiration for all lovers of life and beauty."

But he is forgotten elsewhere. *Birds of the Pacific States* remained in print for fifty years but is now unavailable. As Joseph Hickey, a wildlife ecologist and longtime birder, recently observed, "In looking over Hoffmann's books, one is impressed with the fact that he must have been a terrific field man. One feels embarrassed that the obituary in *The Auk* didn't even spell his name right."

Harold Swanton, a retired writer for radio, television, and the movies, has been a bird watcher for fifty-three years.

The book for everyone who cares about planet Earth's survival

It's an almanac • statistical reference • fascinating history • blueprint for concerned citizens • atlas of natural wonders • picture book of mankind • solar energy handbook • conservation quizbook • world tour of environmental "hot spots" • ecological economics survey • a new perspective on our planet's future—and much, much more...

Jacques Cousteau and the Cousteau Society have created a unique almanac of ecological facts, figures and issues—a book that offers, in one volume, information, entertainment, and a serious call to arms for everyone who asks, "What can *I* do to help?"

864 pages long, and with over 300 photographs, illustrations and maps, in an oversized format, THE COUSTEAU ALMANAC surveys our entire living planet to reveal the often "hushed up," behind-the-scenes stories of environmental crises. But it also previews promising *solutions* to these ecological problems. And it provides a fascinating compendium of vital statistics about everything under the sun, moon, and rain. You'll discover for example:

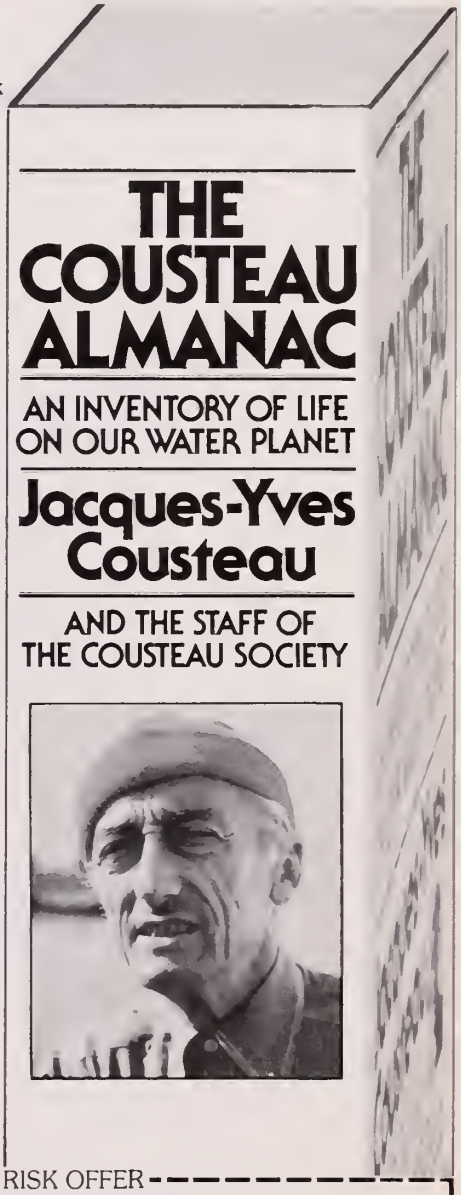
- The biological causes of inflation
- The ironic tale of New York's almost-solar skyscraper
- The typical consumption of a United States citizen (14 pounds of cotton, 187 pounds of meat, 195 packs of cigarettes, 650 pounds of paper and 1,359 pounds of steel per year)
- The "roots" of common man-made items—including paper clips, blue jeans, gasoline, and the Big Mac hamburger
- How to build a better automobile and bicycle
- Things you didn't know you were eating
- How to engineer a famine
- How to make a cow—a recipe that starts with one 80-pound calf, requires more than two years of preparation, and could otherwise feed a thousand people
- The price of war (During World War II, it cost the U.S. an average of $225,000 to kill each enemy soldier)
- The advertisements that saved a canyon
- Animals you'll never see (plus eight endangered species that appear as official symbols of their native lands)
- Large things we've got to save—including the Amazon rain forest, whales, and the ozone layer

An unconventional almanac for uncommon times

"THE COUSTEAU ALMANAC is must reading for all those committed to the successful continuance of humankind in the Universe," writes R. Buckminster Fuller.

Publishers Weekly calls it "an extremely readable, educational book...filled with lore, history, statistics, warnings, suggestions and profiles of influential individuals. ...The contributors touch upon just about every imaginable ecological trend."

Send for your copy now. If you don't agree that this is a book you *must* have, return your copy within two weeks for a full, prompt refund.



DID YOU KNOW THAT...

... a top tourist mecca—the Caribbean—is also the most pesticide-damaged area of the world ocean?

... "acid rain," which has killed the fish in 90% of America's northeastern mountain lakes, is now quietly destroying the Acropolis and many of Europe's greatest cathedrals?

... there are more insects in one square mile of rural land than human beings on the entire earth?

See why Pete Seeger says: "It's much more than a book of dry facts. Every school in the world should have a copy!"

NO RISK OFFER

To your bookseller or
Doubleday & Company, Inc.,
Garden City, New York 11530
Dept. ZA-131

Please send me copies of THE COUSTEAU ALMANAC as follows: _____ copies hardcover @ $29.95 each; _____ copies paperback @ $15.95 each. I enclose my check or money order. I understand you will pay all shipping and handling costs. If I don't agree that this is a book I must keep, I'll return it within 2 weeks for a full prompt refund—no questions asked.

Name_____

Address_____

City_____ State_____ Zip_____

Offer expires June 30, 1982

A Gift for Health

For Someone You Love



NordicTrack

Jarless Total Body Cardiovascular Exerciser

Duplicates X-C Skiing for the Best Motion in Fitness

Highly Effective and Pleasant To Use
The enjoyable sport of cross-country skiing is often cited as the most perfect form of C-V exercise. Its smooth, fluid, total body motion uniformly exercises more muscles and higher heart rates seem easier to attain than when jogging or cycling. NordicTrack closely simulates the same pleasant motion and provides the same cardiovascular endurance-building benefits — right in the convenience of your home. Makes a year round, consistent exercise program easily attainable. Eliminates the usual barriers of time, weather, chance of injury, etc. Also highly effective for weight control.

Better Than Running
NordicTrack gives you a more complete work out — conditions both upper body and lower body muscles at the same time. Fluid, jarless motion will not cause joint or back pains as jogging or running often does.

Better Than Exercise Bikes
NordicTracks stand-up skiing motion more uniformly exercises large leg muscles and also adds important upper body exercise. Higher pulse rates, necessary for building fitness, seem easier to attain because the work is shared by more muscle mass. The NordicTrack also keeps more muscles in tone.

Even Better Than Swimming
NordicTrack more effectively exercises the largest muscles in the body, those located in the legs and buttocks. These muscles main function is to lift and propel the body in the standing position. When swimming, the water supports the body thus preventing these muscles from being exercised as effectively as when they support the body in a standing position.

A Proven, high Quality Durable Product
Ruggedly constructed, NordicTrack is quiet, motorless and folds compactly for storage. Separate arm and leg resistances. NordicTrack is in its 5th year of production and is used in thousands of homes and many companies. We manufacture and sell direct. Our No-Risk 15 day trial guarantee shows our confidence in your being pleased with the performance and quality of the NordicTrack.

This year, give someone you love a gift for better health.

For more information, call or write
PSI 124 L Columbia ct. Chaska, MN 55318
toll free 1-800-328-5888, MN. 612-448-6987

Getting Ready for Halley

Scientists have already begun making plans to observe this born again and again comet, due back in 1985-86

by Stephen P. Maran

"We've been looking for the last three years and we intend to look again in the coming season," said Michael Belton, referring to the current search for Halley's comet. An expert on planets and comets at Kitt Peak National Observatory in Tucson, Arizona, Belton is leading an attempt to make the first sighting of Halley's comet before its grand sweep past the earth and the sun in 1985–86.

Halley's comet has passed this way before; its last trip was in 1910. There are several scientific reasons for trying to make the earliest possible sighting of this previously known comet on its upcoming trip; among them are the desire to determine its physical state while far from the sun, the opportunity of measuring the size of the nucleus before it starts shedding material and gaining increased knowledge of the comet's orbit as a navigation aid for planned cometary space missions, and to assist in pointing the Space Telescope correctly. There is also the nonscientific reason that whoever is first to sight the comet will be assured of a place in astronomical history. The most famous comet observation of all time was made by an eighteenth-century German farmer, Johann Palitzsch, who was first to spot Halley on its trip through the inner solar system in 1758. Without that feat he would surely have remained unknown. Instead, Palitzsch is remembered in any number of historical accounts and books about comets.

Palitzsch upstaged the professional astronomers of 1758 by sighting Halley's comet on Christmas Day, on its first return following the prediction by the English astronomer Edmond Halley. The return not only verified Halley's prediction but also lent increased weight (if I may use that phrase) to Isaac Newton's theory of gravity and the gravitational effects on the motions of objects in space. Needless to say, the return had been eagerly awaited by the scientists of the world. So much so that Voltaire is said to have quipped that "astronomers never went to bed in 1758 for fear of missing the comet" (see "The Comet Syndrome," *Natural History*, December 1980).

This time around, however, the professionals are not about to be upstaged. Belton, for example, is using the 4-meter (159-inch) Mayall Telescope at Kitt Peak, equipped with a sensitive television camera that makes time exposures. Also, a group at the Mount Palomar Observatory in southern California is employing the famous 200-inch Hale telescope, together with an advanced solid-state detector "chip," which is refrigerated to within a few degrees of absolute zero to attain maximum sensitivity. No amateur, as far as is known, can command comparable instrumentation.

The predicted brightnesses of comets are always uncertain, as was underlined when great visibility was anticipated for comet Kohoutek (see "A Funny Thing Happened to Comet Kohoutek," *Natural History*, March 1974), but failed to develop. Nevertheless, for what it's worth, the predicted brightness of Halley's comet this fall, when Belton and others will continue to search, is 24th magnitude. This is about sixteen times (or three magnitudes) fainter than the dimmest stars and galaxies on the Palomar Observatory Sky Survey, which

A new and original work in porcelain
by the world's foremost portraitist of butterflies

T·H·E MEADOWLAND BUTTERFLY VASE

BY JOHN WILKINSON

In fine porcelain,
hand-decorated with pure 24 karat gold.

Your commission must be entered by
November 30, 1981.

The British artist, John Wilkinson, has been described as "the most outstanding portraitist of butterflies in the world today." And he is widely regarded as one of the foremost nature artists of our time.

Now this celebrated artist has designed his *first* work of art *in porcelain*: The Meadowland Butterfly Vase. This new work is a significant contribution to the porcelain medium, and is certain to be a source of lasting pleasure to any collector who possesses it. Furthermore, it will be a magnificent accent to any room in the home.

The Meadowland Butterfly Vase will be crafted in fine white porcelain—ideal for portraying the rich colors and graceful lines of Wilkinson's art. For his subject, the artist has chosen the loveliest butterflies that are seen in a sunny spring meadow. The Admiral, with its golden wings and distinctive black markings. The Painted Lady, softer in tone and elegantly graceful in flight. The Mourning Cloak, dramatic in tones of deep rust, blue and yellow. And the Purple Wing, aptly named for the shimmering beauty of its colors.

The artist has not only depicted the variety of shades and tones of the butterflies—using 16 different colors—but has captured the atmosphere of the English countryside as well. The height of the vase (11¼") provides ample room for this superb depiction. And, to add the final touch of refinement, the vase will be *hand-decorated* with a band of *pure 24kt gold* surrounding the crown and the base.

The Meadowland Butterfly Vase will be issued exclusively by Franklin Porcelain, and the responsibility for its creation has been entrusted to Franklin Porcelain of Japan, where there is a thousand-year-old tradition of crafting vases in fine porcelain.

A LIMITED EDITION. Advance orders for the vase are being accepted until November 30, 1981. A later announcement of this work will be made, but no orders will be accepted after the end of 1982. The issue price is $95, plus $3 shipping and handling, payable in four monthly installments of $24.50 each. The vase will be accompanied by specially written reference information and a Certificate of Authenticity.

To enter your commission, be sure to mail your order to Franklin Porcelain, Franklin Center, PA. 19091, by November 30th.



Vase shown smaller than actual size of 11¼" high. Hardwood stand included.

© 1981 FP

ADVANCE ORDER FORM

The Meadowland Butterfly Vase

Valid only if postmarked by November 30, 1981 • Further limit: One vase per person.

Franklin Porcelain, Franklin Center, Pennsylvania 19091

Please send me The Meadowland Butterfly Vase by John Wilkinson, to be crafted for me in fine porcelain and hand-decorated in pure 24kt gold. The hardwood stand will be included.

I need send no money now. Bill me for the vase in four monthly installments of $24.50* each, the first installment due in advance of shipment.

**Plus my state sales tax*

Signature _____
ALL ORDERS ARE SUBJECT TO ACCEPTANCE

Mr. / Mrs. / Miss _____
PLEASE PRINT CLEARLY

Address _____

City, State, Zip _____

BEAUTIFUL WILDLIFE PRINTS

• • •

Limited to only **600** prints, both of these full color prints are reproduced on 100% rag paper and are **signed and numbered by the artist.**

Master printers have faithfully reproduced these magnificent paintings by two of America's finest wildlife artists.

• • •

Your complete satisfaction is guaranteed.





"Young Cougar"
by James E. Foulkner
(above) 16x20"
unmounted $58

• • •

"Snowy Owl"
by Michael J. Riddet
(left) 16x20"
unmounted $56

• • •

Both prints with matching numbers — unmounted $105

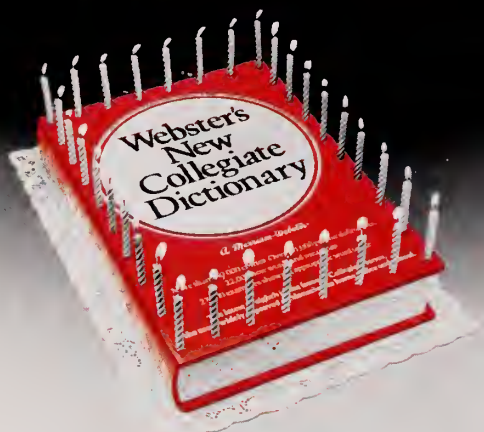
• • •

No charge for prompt first class shipping. MC & VISA accepted

• • •

NATURE'S NEST
1426 Pearl Street A
Boulder, CO 80302
(303) 443-2245

ses·qui·cen·ten·ni·al



Webster's New Collegiate Dictionary. It's where the words live.

For 150 years, G. & C. Merriam has been bringing the language to life and life to the language. Today, the best-selling Webster's New Collegiate offers 150,000 words, including 22,000 new entries. Get a taste of "Fast Food," feel an affinity for "Clone," and share in the celebration of our "Sesquicentennial." In 150 years, dictionary has never meant so much. Just $12.95, indexed. A gift of lasting value.

FROM MERRIAM-WEBSTER®

© G &C MERRIAM 1980



Halley's comet, May 4, 1910

means that the comet seekers will be scanning uncharted skies as they attempt to locate Halley's comet.

Even the faintest already charted stars, the Palomar Survey's 21st-magnitude objects, are so much brighter than the anticipated brightness of Halley's comet this fall that these extremely faint stars represent sources of interference in the comet search. Stars and galaxies this faint are also very numerous; they literally pepper the sky. Thus the strategy of searching for Halley's comet at its present vast distance, well beyond the orbit of Saturn, consists of examining the Palomar Survey photographs to find those places along the comet's predicted track where the faint but potentially interfering stars are least numerous. Observations are then scheduled for the nights when the comet's track will take it to those points. The most favorable night of the current season at Kitt Peak, Belton says, will be December 25—shades of Johann Palitzsch. Unfortunately, as one of several economy moves, the Kitt Peak Observatory recently adopted a policy of shutting down at Christmas.

Intensive observations of Halley's comet will begin in 1985 as it brightens while moving in toward the sun, making its closest approach to the earth in late November, then rounding perihelion (the closest point to the sun on the



Yerkes Observatory

comet's orbit) in February 1986. During 1985–86, the comet will be observed worldwide by NASA's International Halley Watch, a coordinated program of measurements and photographs by optical and radio telescopes strategically located to maintain an hour-by-hour survey of Halley's changing form and spectral emissions. Astronauts may pilot the Space Shuttle in a low Earth orbit as onboard telescopes focus on the ultraviolet radiation from the comet. Ultraviolet rays carry much information about cometary atoms and molecules, but cannot penetrate the earth's atmosphere and thus must be observed from space. If all goes well, the Space Telescope, a large, free-flying spacecraft carrying the most powerfully equipped telescope ever made, will be dropped into Earth orbit by the Space Shuttle in mid-1985. It too will observe Halley's comet.

The most exciting plans, however, involve the first attempts to send space vehicles to fly past the comet. At least three missions to be launched toward Halley's comet are currently in the works: one to be controlled by the Soviet Union, one by the Japanese, and one by the European Space Agency. The Soviet mission apparently comprises two spacecraft, which will fly to Halley by way of the planet Venus. The other missions involve one spacecraft each. As this column was being written in early



The Chivas Regal of Liqueurs.

Chivas Brothers make the world's finest Scotch. And the same renowned Chivas quality and tradition goes into its equally-regal Lochan Ora Liqueur. With a unique taste all its own. Lochan Ora is to be lingered over—sipped slowly, savored fully. It's expensive but, then, good taste invariably is.

Lochan Ora.

The Imported Liqueur from Chivas Brothers.

70 PROOF • IMPORTED BY GENERAL WINE & SPIRITS CO N Y N Y

summer of 1981, NASA had no approved mission to Halley, but authorities were discussing a possible American space probe capable of taking more and better photographs than the "foreign" craft and equipped to collect cometary particles for return to Earth and chemical analysis in laboratories on the ground.

Despite all of the above, Belton and the other early Halley seekers are not jumping the gun. It is important to locate and observe the comet as soon as possible to determine its "far out" state, meaning its physical condition while still far from the sun and the solar influence. In the next few years, as the nucleus of the comet—a ball of frozen water and the ices of other substances, mixed up with a fine powder of rocklike dust—approaches the inner solar system, the sun's rays will warm it. Evaporating gases will form the head, or coma, dwarfing the tiny nucleus, and will stream backward from the coma in the direction opposite the sun, to form a yellow dust tail and a blue plasma tail. The latter will be composed of electrified gases and can be expected to show abrupt changes of form as the onrushing Halley encounters disturbances in the solar wind.

The nucleus is the only part of a comet that returns from one passage around the sun to the next. All the gas and dust of the coma and the tails is lost in space. Each time Halley's comet returns from the outer reaches of the solar system (its aphelion, or point farthest from the sun, is beyond the orbit of Neptune), its nucleus sheds material to form a new coma and new tails. As a result, the nucleus is gradually shrinking, and one day it will no longer exist. It may split apart, crumble, or just plain vanish. Nobody knows. A few astronomers, including those mainland China researchers who have analyzed ancient Chinese records, claim that Halley has been gradually fading over the centuries, perhaps due to the shrinkage effect, but this conclusion has not been clearly substantiated.

If the searchers succeed in finding Halley's comet while it is still far from the sun and before the coma has formed, their observations should reveal just how large the nucleus is. It's a fairly simple matter: we know how bright the sun is, so the observed amount of reflected

Genuine Uncut
2 CARAT DIAMOND



Exquisitely Captured in Solid 14 KT Gold
An Unforgettable Gift. Only $199

Now, you can give a Natural Beauty GENUINE uncut 2 carat diamond in a 14 KT gold cage for only $199.

The Diamond Pendant is so unusual it will be admired and commented upon by all who see it. To be worn proudly on all occasions by any woman who covets a 2 carat diamond.

A polished gemstone diamond as large as this, would be worth thousands of dollars. But because these are selected rough, uncut diamonds — just as they come out of the diamond fields -- we are able to offer them at an amazing price. No two diamonds are exactly alike, all are guaranteed to be genuine and weigh at least 2 carats.

The Natural Beauty 2 carat uncut diamond caged in solid 14 KT gold is an exclusive of Columbia Minters — known for quality and value.

Order yours today — due to the ever changing price of diamonds on the world markets this exceptional price cannot be guaranteed beyond November 30, 1981. Your complete satisfaction is guaranteed or return within 10 days for a full refund.

Please specify Box, Triangle or Teardrop setting on order form.

VALID ONLY UNTIL NOV. 30, 1981

D317

Columbia Minters 905 Sixteenth Street N.W., Washington, D.C. 20006

Please send me_____ genuine 2 carat diamond(s) in the solid 14 KT gold cage(s) I have indicated below, for only $199 plus $3 postage and handling. Also send me_____ 14 KT gold neckchain(s) as illustrated at $125. each. If I am not satisfied in anyway, I may return my order within 10 days for a full refund.

____Box Setting ____Oval Setting ____Lantern Setting

☐ Enclosed is my remittance for $_____ or

☐ Charge $_____ to my

☐ American Express ☐ Diner's Club

Card No. _____ Exp._____

Signature _____
(Charge orders must be signed to be valid)

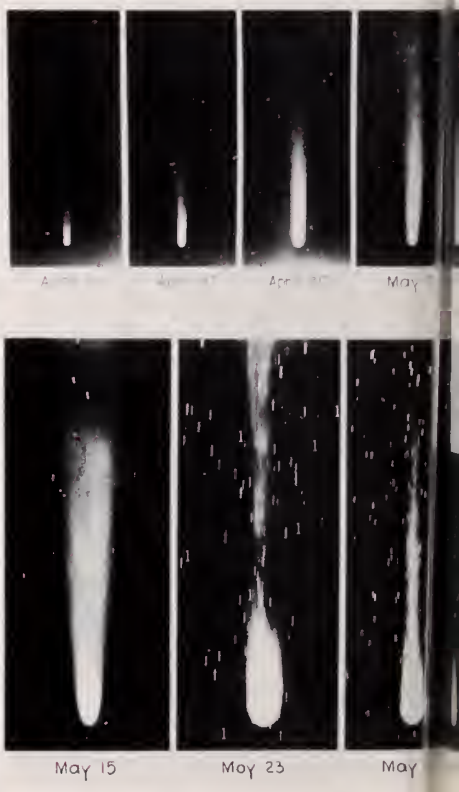
Name _____

Address _____

City _____ State_____ Zip_____

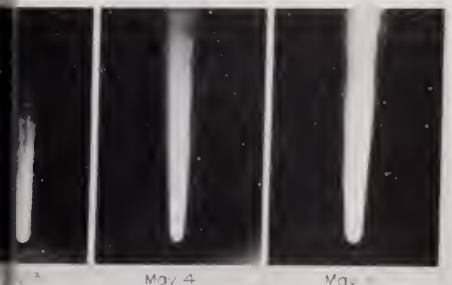
For faster service, credit card charge orders may call FREE — 24 hours a day
800-228-5000

©Columbia Minters 1981

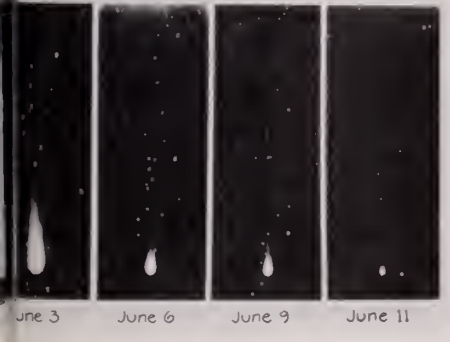


sunlight from the Halley nucleus, at its known distances from the sun and the earth, will tell how big the nucleus must be. More accurately, the reflected sunlight will provide an estimate of the nucleus size that depends on the albedo, or reflectivity, of the nucleus. A small, light-colored nucleus would reflect more sunlight than a larger, darker nucleus. Further, the surface texture will affect the amount of light reflected in different directions. Thus, a nuclear surface covered by many tiny particles—whether light or dark—would reflect light differently from a smooth, icy surface of the same light or dark shade.

Fortunately, the albedo can also be measured. In November 1980, Belton looked in vain for Halley's comet and concluded that he might have detected it had it been as large as sixteen miles in diameter. (The Palomar team came to a similar conclusion.) That's no surprise, for modern cometary scientists believe that the nucleus of even a big comet such as Halley may be no more than a few miles across although estimates published not many years ago were larger. Once the coma forms as the nucleus approaches the sun, it will be

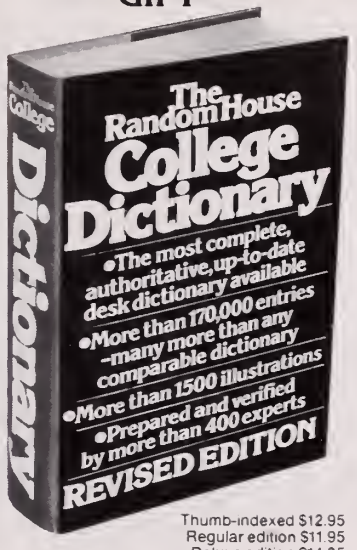


Halley's Comet in 1910



Hale Observatories

THE Smart GIFT

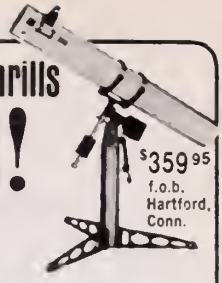


Thumb-indexed $12.95
Regular edition $11.95
Deluxe edition $14.95

Now at your bookstore RANDOM HOUSE

Publishers of *The Random House Dictionary of the English Language. Unabridged Edition*

Share the Thrills of Exploring Outer Space!



$359.95 f.o.b. Hartford, Conn.

Now it's easy to join the thousands of serious amateurs who have discovered the excitement of exploring our mysterious universe. Your enjoyment begins right from the start, yet the challenges and rewards go on for years! And it's a hobby that can be shared at modest cost.

Choose From Many DYNASCOPES®

Picking a telescope to fit your needs and your pocketbook is simple when you select a DYNASCOPE—the same instruments used by more than 150 schools, colleges and observatories—and your satisfaction is guaranteed by a full-refund warranty.

FASCINATING GUIDE YOURS FREE!

Read these valuable facts before buying any telescope. Mail coupon or postcard for your complimentary copy of this helpful guide.



Criterion Manufacturing Co.
620 Oakwood Ave., W. Hartford, Conn. 06110

® TM Registered U.S. Pat. Office

CRITERION MANUFACTURING CO., Dept. NH109
620 Oakwood Avenue., W. Hartford, Conn. 06110
Please send your free Telescope Guide.
Name_____
Address_____
City_____ State_____



Beautiful Early American "COLONIAL LOFT" BEDSPREADS

- Heavy—soft—durable
- 100% Quality Cotton
- Machine washable
- Choose white or natural
- Special Prices:

Twin 80 x 110, value $40..... only $29.95
Full 96 x 110, value $45..... only $35.95
Queen 102 x 120, value $55.... only $43.95
King 120 x 120, value $65..... only $49.95
Sham (standard), value $12 . only $9.95 ea
Add $2.50 per order for shipping

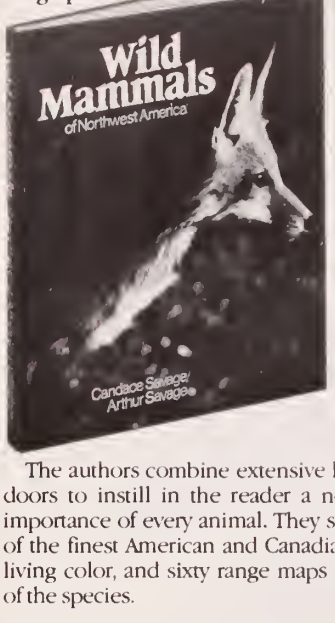
100% Natural Cotton, soft but ever so durable. A true legacy of Early America. This elegant woven bedspread is fully pre-shrunk and machine washable, with no ironing ever. Rich, full, all-cotton decorator fringe. **Guaranteed.** We ship fast.

Homespun Crafts • Dept. NH-2, Box 1776, Blacksburg, S.C. 29702

Gentlemen: Please rush _____ "Colonial Loft"
____ Size spreads & ____ shams, color: _____
☐ Check ☐ M.O. enclosed ☐ M.C. ☐ Visa
Credit Card No. _____ Exp. Dt. _____
Name _____
Address _____
City _____ State _____ Zip _____
M/C, VISA orders—call Toll Free: 800-458-3491, Ext. 83-R
CALL NOW!

Illustrated with more than 100 large color photographs.

Wild Mammals
of Northwest America



by Arthur Savage and Candace Savage

Did you know that: porcupines can sing? beavers build mud pies to mark their territories? coyotes and badgers sometimes hunt together? wolverines have been known to kill bull moose? mountain goats make a game of turning somersaults? These are only a few of the fascinating facts revealed in *Wild Mammals of Northwest America.*

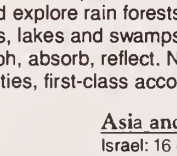
This attractive, informative volume —illustrated with more than one hundred large color photographs— explores the behavior, ecology, and natural history of seventy different North American mammals.

The authors combine extensive knowledge with a natural love of the outdoors to instill in the reader a new appreciation of the uniqueness and importance of every animal. They supplement the text with a large selection of the finest American and Canadian nature photography, all reproduced in living color, and sixty range maps illustrating the present distribution of all of the species.

$25.00 through December 31, 1981
$27.95 thereafter

Available at your local bookstore or from

The Johns Hopkins University Press
Baltimore, Maryland 21218



The 1982 Program

Stimulate your mind on a Questers nature tour. We search out the plants and animals, birds and flowers...and explore rain forests, mountains and tundra, seashores, lakes and swamps. There is ample time to photograph, absorb, reflect. Naturalist guides, small tour parties, first-class accommodations.

Worldwide Nature Tours
1982 Departures

The Americas

Everglades: 11 days, Apr. 8, Nov 4 • Hawaii: 15 days, Feb. 14, Mar. 21, Oct 10, Dec 19 • Alaska: 17 days, June 12, 26, July 10, 24, Aug 7 • Pacific Northwest: 12 days, June 20, Aug. 1 • Superior Forest Canoe Trip: 9 days, July 10, Aug 14 • Northwest Canada: 16 days, July 2 • Churchill: 11 days, July 17 • Newfoundland: 16 days, June 13 • Baja California: 11 days, Apr 16, Oct. 15 • Southern Mexico: 14 days, Feb 14, Dec. 19 • Costa Rica & Panama: 16 days, Feb. 13, Nov 20, Dec. 18 • The Amazon: 17 days, Jan 17, May 9, July 4, Aug 8, Oct 10, Nov 14 • Galapagos: 15 days, Jan. 28, Apr 22, July 15, Aug 5, Oct 28 • Peru: 23 days, July 17, Nov 6 • Patagonia: 21 days, Nov 6 • Trinidad & Tobago: 11 days, Mar 8, Nov 8

Europe

Iceland: 16 days, June 11, July 2, Aug. 6 • Islands/Highlands of Scotland: 21 days, May 27, July 15, Aug 19 • Switzerland: 17 days, July 16, Aug 13 • Greece: 19 days, Mar. 29, Sept. 20 • Spain: 20 days, Apr. 16, Sept. 3

Asia and Africa

Israel: 16 days, Mar. 15, Oct. 18 • The Himalayas: 23 days, Mar. 18, Oct. 7 • India: 23 days, Jan. 30, Oct. 30, Nov 27 • Sri Lanka: 18 days, Feb. 19, Nov 19 • Kenya: 23 days, Feb. 4, July 22, Oct. 21 • Zimbabwe & Botswana: 19 days, July 8, Aug 5.

Australasia

Australia & New Zealand: 30 days, Feb 13, Oct. 2 • New Zealand & the Milford Track: 22 days, Feb. 12, Nov 12 • The Complete Australia: 35 days, Sept. 3

To learn more, write requesting the 1982 Directory of Worldwide Nature Tours. Indicate if you are interested in any particular tour and we will send the corresponding Detailed Itinerary



QUESTERS
Questers Tours & Travel, Inc.
Dept. NH, 257 Park Avenue South
New York, NY 10010 • (212) 673-3120

difficult to separate the brightness of Halley's nucleus from the brightness of its coma and thus to gauge the size of the nucleus.

As the comet rounds the sun and displays the full panoply of cometary phenomena, as I think it will, Halley will shed a huge amount of ice, dust, and gases. The quantities of each will be determined by the many observations that are planned. Finally, as the comet recedes into deep space, to return next in the second half of the twenty-first century, it will shed its coma and tails, permitting a final glimpse of its born-again unadorned frozen nucleus.

If all goes well, the planned studies of Halley's comet may tell us what a cometary nucleus is really like. Although it is generally believed to be a "dirty snowball" of ice and rock dust, recent ground-based observations have raised some doubts. In fact, one paper presented not long ago at a comet conference in Tucson was provocatively titled "Where Is the Ice in Comets?" Infrared measurements from several observatories indicate that comet nuclei have the same general reflective properties as many asteroids. Yet asteroids have no atmospheres (comets do—the coma, or comet head, is an atmosphere) and surely are made of rock, while the presence of frozen water and other icy substances somewhere in the nucleus of a comet is proved by the fact that when the nucleus nears the sun, the coma forms around the nucleus. Current thinking holds that volatile materials sometimes are shed from the nucleus surface, leaving an outer crust of rock dust. According to this reasoning, the gases that stream outward to form the coma of a crusted comet evaporate from ices located below the surface of the nucleus and flow out of it through tiny channels in the crust. This would account for the observed infrared reflectivities and explain the coma, but the idea is definitely in need of verification. Measurements from a spacecraft close to the nucleus of Halley's comet, if any spacecraft gets there, could answer this question. One of the problems, of course, in approaching a cometary nucleus is the danger of collision with numerous small, or a few large, rock particles.

An early sighting of Halley's comet will help astronomers chart its path more closely. In the past, slight deviations from the expected path have led some astronomers to claim that the comet was slightly off track due to the gravitational pull of an as-yet-undiscov-

ered Planet X, located somewhere beyond Pluto. This claim has been rejected, although there still may be a little planet out there, too small and far away to noticeably disturb Halley. The comet does deviate from a precisely predictable path because evaporating gases give it some propulsion of its own. A reasonably accurate path, computed early thanks to an early sighting, might enable ground controllers to steer their space probes closer to the comet, and to point the Space Telescope with increased exactness so as to track Halley better.

There is special interest in determining what, besides water ice and rock dust, Halley or any comet is made of. Many atoms and molecules have been observed in the heads and tails of comets, but most of them are so-called daughter products. They are fragments of larger parent molecules, which evaporate from the nucleus and are then swiftly broken into daughter products by the sun's ultraviolet rays and by collisions with other particles. To identify most of the parents, it will be necessary to point or steer the sensing instruments into Halley's inner coma, where the parents can still be detected before they disrupt.

The viewing conditions for Halley in 1985–86 will not be as favorable as they were during its 1910 appearance. When the comet is brightest near perihelion in February 1986, it will not be observable from the ground. Nevertheless, past experience assures me that we will soon be receiving glossy brochures advertising comet-viewing cruises, and that suitably decorated Halley T-shirts, first-day postal covers, souvenir plates, bumper stickers, and crystal beer mugs cannot be far behind. At least one group will announce the end of the world, as is done every time a famous comet appears. Despite the impending hoopla, however, serious scientific investigations are in the planning stages and under way, and much should be learned.

Comets are widely believed to be the frozen debris of the material from which the sun and planets formed. If so, the intensive study of Halley's comet over the next few years may establish the facts we need to take us back five billion years in time to the origin of the solar system.

Stephen P. Maran is a senior staff scientist in the Laboratory for Astronomy and Solar Physics at NASA's Goddard Space Flight Center in Greenbelt, Maryland.

INDIA. EVEN IN OUR HOTELS THE PAST AND THE PRESENT ARE ALIVE.



Spend some time floating in your own houseboat.



Enjoy some of our modern hotels. Swimming, golf, tennis, anyone?



Stay in a shimmering lake palace.

India.

There's romance, luxury, mystery, excitement. And comfort.

Even our hotels are different.

Wonderfully modern (often with golf and tennis available) and wonderfully exotic. And that's only the beginning.

There's art and music, fairs and festivals.

You'll meet holy men, do yoga on a beach, shop in glittering bazaars.

You'll see incredible wildlife, rugged mountains, visit the Taj, the world's most beautiful building. And dance the night away if you wish.

Whatever you want we have. And even more.

We have the unexpected.

Try one of our tours. We have many, many choices.

See your travel agent or send us the coupon and find out everything about Unbelievable India.

UNBELIEVABLE INDIA

NH11

Please send me information on Unbelievable India

Name

Address

City

State. Zip

GOVERNMENT OF INDIA TOURIST OFFICE
30 ROCKEFELLER PLAZA NEW YORK N.Y. 10112 (212) 586 4901 3550 WILSHIRE BLVD LOS ANGELES CA 90010 (213) 380-8855
230 N. MICHIGAN AVE. CHICAGO IL 60601 (312) 236-6899 POST BOX 342 T.D. CENTRE TORONTO CANADA (416) 36[illegible]188
MIAMI FLA (305) 944 7039 DALLAS TEXAS (214) 234-2233 SAN FRANCISCO CA (415) 564 2973

Celestial Events

by Thomas D. Nicholson

The Moon The waxing crescent moon decorates the western sky at sundown in early November, passing through Sagittarius on the 1st and 2nd, and entering Capricornus to become the first-quarter moon on the 4th. Full moon is on the 11th, and the waning gibbous moon is above Aldebaran, in Taurus, on the 12th. On the 17th and 18th, the last-quarter moon passes Regulus in Leo, as the moon and the star rise shortly before midnight. New moon is on November 26, and the crescent moon of the next cycle should be seen on the 29th and 30th. In early December, first-quarter moon is on the 4th, full moon on the 11th. Perigee moon (nearest the earth) is on November 12 and December 10, apogee (farthest from the earth) on November 26 and December 23.

Stars and Planets The planet scene has clearly shifted into the morning sky this month (except for Venus), focused in Virgo, where Jupiter and Saturn cluster on either side of the bright star Spica. Look for the three from before dawn until they fade in the morning twilight. They rise as a triangle about four hours past midnight; Saturn will lead them, followed by Spica (to the left) and Jupiter (easily the brightest of the three). During the first week of November, Mercury passes through the group to make it a "four-star" event (three are actually planets, of course), and late in the month the waning crescent moon highlights the trio (see illustration below). Venus is the only bright evening planet. It reaches greatest easterly (evening) elongation on the 10th, which ordinarily places it in the best position for viewing as an evening star. But this evening configuration of Venus is poor even at its best. Were it not for Venus's brilliance, it might go unnoticed. But bright it is (approaching its greatest brilliancy in mid-December), so don't be surprised to see that beacon flash out in the west-southwest any evening during late twilight if the western sky is clear or partly cloudy.

November 1: Look for the "teapot" of stars that marks Sagittarius, just below the crescent moon.

November 1–2: The Taurid meteor shower reaches maximum tonight, during after-midnight hours. It is not particularly bright or numerous (about 15 per hour at maximum), but there is no moon to interfere with viewing.

November 2–6: Mercury reaches greatest westerly (morning) elongation on the 2nd, and this is a favorable morning cycle for the planet. Look for the planet near the "triangle" formed by Saturn, Spica, and Jupiter. Mercury (brighter than Spica, but less than half Jupiter's brightness) is closest to Spica on the 2nd, closest to Jupiter on the 5th. Binoculars will help. By putting Jupiter in the center of the field, Mercury should be easily visible on the 4th, 5th, and 6th. Spica is below and to Jupiter's right and much more distant than Mercury on those mornings.

November 12: Expect stronger than usual tides today and tonight as the effect of the perigee moon adds to the spring tide accompanying the full moon of the 11th.

November 16–17: The last-quarter moon will brighten the after-midnight sky during maximum of the famous Leonid meteor shower. This is also not a very productive shower (15 per hour at maximum in normal years), but the meteors are swift and often very bright. You should see some, with patience, despite the moon.

November 22–23: These are the mornings to watch the waning crescent moon pass the trio of Saturn, Spica, and Jupiter. The moon is nearest to Saturn on the morning of the 22nd, and to Jupiter on the 23rd, passing above both.

November 30: The new crescent moon will guide you to Venus tonight. Look below the crescent as it becomes visible in the western twilight sky.

December 10: Mercury is in superior conjunction with the sun.

December 11: Another perigee spring tide occurs.

December 13–14: The relatively productive Geminid meteor shower (50 per hour) will be partly spoiled by the brightness of the full moon.

Editor's Note: The Celestial Events Sky Map in the October issue shows the evening constellations and stars for this month and gives the times for use.



Helmut Wimmer

Jupiter and Saturn, prominent evening stars this past summer, have now shifted to the morning sky, where they join the star Spica this month, rising in the east and visible from before dawn until twilight. Mercury passes the three objects in early November, as it goes through a favorable "morning" elongation, and the waning crescent moon highlights the trio in late November. This view shows the objects in the morning sky at about 5:00 A.M., looking east.



"Planet Earth has a furnace inside," says Glen E. Campbell, Gulf's Geothermal Supervisor. "The heat is generated by the natural radioactive decay of elements deep in the earth, and is conducted outward toward the surface.

"But the earth's crust isn't the same thickness everywhere. So in some places, this geothermal energy is buried miles deep, and in other places it comes right to the surface as volcanoes, geysers or hot springs.

"In many areas of the world, including the western U.S., geothermal resources hot enough to generate electricity come fairly close to the surface. In one such area, at Steamboat Springs, near Reno, Nevada, Gulf and another energy company are working on various techniques for extracting heat from the earth and putting it to work generating electricity.

"The potential is tremendous. Government figures show that the geothermal resources within the U.S. could free roughly a million barrels of oil per day for other uses."

Geothermal energy could be a big step toward energy independence. It's part of the business Gulf is in: energy for tomorrow.

Gulf

Gulf people: energy for tomorrow.

© Gulf Oil Corporation 1981

Electricity from Earth's body-heat.



"Generating electricity from geothermal resources could save America a million barrels of oil every day."

Ala



Elegant Hotels. Skylighted atrium lobbies, rooftop dining, nightly entertainment, and luxuriously appointed guest rooms are typical amenities offered by many hotels.



Luxury Cruising. An astonishing contrast of luxury and the primal forces of nature—in shirtsleeve weather.



Anchorage. A major stopover for travelers en route to Europe or the Orient, Anchorage offers residents and visitors alike the excitement and conveniences of a modern city surrounded by the beauty and adventure of Alaska's wilderness.



Red Fox Cubs. Katmai National Park and Preserve, a medium-sized park by Alaska standards, is twice the size of Delaware. Red fox flourish here, along with populations of moose, wolf, lynx, bald eagles, whistling swans, sea lions, and sea otters.



Arctic Alaska. Eskimo dances, the blanket toss, demonstrations of skin sewing, ivory carving, and other traditional activities of a six-thousand-year-old culture welcome visitors to far north Alaska.



Send for your FREE 132-page book that shows how to enjoy an Alaska vacation!

Alaska offers so much, so memorably, in so many ways. It's one of the great vacation experiences of world travel. This free book will help you customize your trip to perfectly fit your interests and your available time. **Worlds of Alaska and Canada's Yukon** contains 132 full-color pages of evocative description, action photography, invaluable information, and thoughtful details that will help you make the most of your Alaska vacation. You'll discover all the places you want to see and all the things you want to do, carefully organized and graphically illustrated with photos, maps, and charts. More than 1,300 visitor services are listed, and advertisements describe the most current offerings from Alaska's tour, transportation, and lodging companies. Read **Worlds of Alaska and Canada's Yukon,** and discover a land of limitless adventure. You'll be ready for the best vacation ever— in Alaska!

Alaska Travel Planning Guide. FREE!

☐ Yes! Send my free copy of Alaska's official vacation planning guide. I'll expect delivery by Third Class Mail in three weeks.

☐ Quick! I can't wait to get started! Send my free copy of Alaska's travel guide by First Class Mail. I enclose $2 to cover postage and handling.

Name _____
(Please print clearly)

Address _____

City _____ State _____ Zip _____

(Delivery begins October 10, 1981. Allow three weeks for Third Class delivery.)

Additionally, I am interested in more specific information on:

Travel to Alaska:
1. ☐ By Car, Camper, Motorhome
2. ☐ By Air
3. ☐ By Cruiseship from California
4. ☐ By Cruiseship from British Columbia
5. ☐ By State Ferryliner
6. ☐ By Motorcoach or Rail
7. ☐ Hotels & Motels
8. ☐ Lodges, Resorts & Cabins
9. ☐ Tours to Alaska from U.S. or Canada
10. ☐ Tours within Alaska
11. ☐ Camping in Parks & Forests
12. ☐ Fishing
13. ☐ Sightseeing & Attractions
14. ☐ Adventure Travel (guided hiking, trekking, boating, canoe & raft trips)
15. ☐ Fly-Drive Programs
16. ☐ Guided birding, wildlife, and photo trips
17. ☐ Winter Sports & Vacations
18. ☐ Conventions & Incentive Travel
19. ☐ University of Alaska, Fairbanks: Summer Sessions

To be sure we send you the information you need, please complete the following:

20. What year are you likely to visit Alaska?
☐ 1982 ☐ 1983 ☐ 1984 ☐ 1985 & beyond
☐ I'm undecided about visiting Alaska
21. Your age: _____
22. Level of education completed: ☐ Grade School ☐ High School ☐ College ☐ Graduate School
23. How many visitors will your party include? _____
How many under age 10? _____
24. How do you plan to travel? ☐ By group ☐ Independently
25. In the past 3 years have you taken a vacation trip outside the North American continent? ☐ Yes ☐ No

Offer expires December 31, 1982.

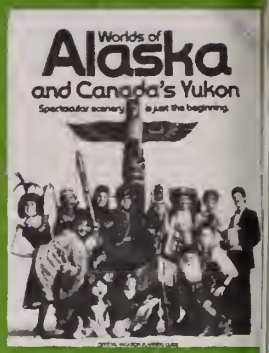
Thank you!

FREE BOOK OFFER!

Alaska's Official
Vacation Planning Guide.

Send this prepaid postcard today.

(See other side for complete details.)



NO POSTAGE
NECESSARY
IF MAILED IN THE
UNITED STATES

BUSINESS REPLY CARD
FIRST CLASS PERMIT NO. 22, JUNEAU, ALASKA 99811

POSTAGE WILL BE PAID BY ADDRESSEE

Worlds of Alaska!

Alaska State Division of Tourism
Pouch E-13
Juneau, Alaska 99811

ska!



Totem Poles. In Sitka National Historical Park, scenic walking trails provide easy access to traditional totem poles set in a lofty forest of spruce and hemlock.



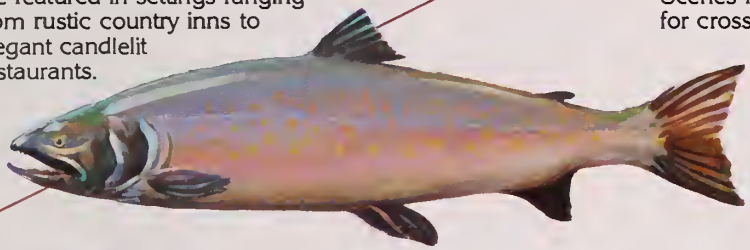
Dining. Fresh Alaska seafood, international cuisine, and a surprising variety of ethnic specialties are featured in settings ranging from rustic country inns to elegant candlelit restaurants.



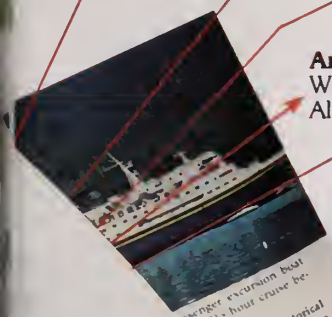
Alaskan Artistry. Visitors discover value in a wide range of gifts produced by local artisans, including original art prints, scrimshaw, beadwork, furs, and carvings.

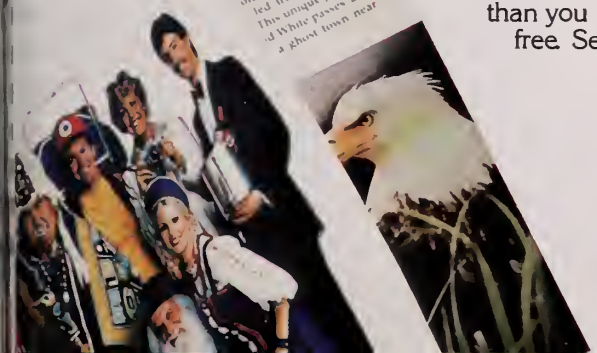


Matchless Winter Sports. Scenes like this are the backdrop for cross-country skiing, dog sledding, and winter hot-air ballooning over snowy peaks.



Arctic Char. One of many magnificent sportfishing species found in Alaskan waters. With more than a million freshwater lakes and thousands of streams and rivers, Alaska offers sportfishing experiences to suit the most discriminating angler.





Send for your FREE 132-page book that shows how to enjoy an Alaska vacation!

Alaska is the vacation experience of a lifetime and this book will start you on your way. It's packed with useful information on how to plan your Alaska vacation. How to get there, what to see, what to do, where to stay, what to look for when you are shopping, and how to make it all fit your budget. You'll discover Alaska is warmer, closer, more comfortable, and more affordable than you ever imagined. **Worlds of Alaska and Canada's Yukon.** It's free. Send for it today.

SEND THIS REPLY CARD FOR YOUR FREE BOOK TODAY!

If the pre-paid reply card has been removed, write:
Alaska State Division of Tourism, Pouch E–13, Juneau, Alaska 99811.

Hare Trigger

Toxins produced by heavily browsed plants may play a critical role in regulating the ten-year snowshoe hare cycle

by John P. Bryant

In the spring of 1911, the naturalist Ernest Thompson Seton was traveling north from Winnipeg, Manitoba, to begin exploration of the Slave River region in subarctic Canada. As seemingly endless miles of dense black spruce forest and fire-scarred shrubland slid silently past his train window, he noted in his journal that "last year had been . . . a year in which the ever-fluctuating population of Northern Hares had reached its maximum . . . nine-tenths of the bushes in sight . . . had been barked at snow level. . . . But the fact that we saw not one rabbit shows that the 'plague' had appeared, had run its course, and nearly exterminated the species in this particular region."

Thus Seton described the crash phase of the ten-year cycle of the snowshoe hare (*Lepus americanus*)—the most striking of the cyclic fluctuations that characterize grouse and small mammal populations of the North American and Eurasian subarctic regions.

Seton and other naturalists observed long ago that during the peak phase of the cycle—when hares are most abundant—hare populations frequently exhaust their winter food supply. Recent work has confirmed this observation and suggests that the key to what triggers the hares' decline may well lie in the interaction of the hares and their food. This interaction, however, appears to be more complex than a simple depletion of the hares' winter browse supply. My research and that of my associates at the Institute of Arctic Biology at the University of Alaska indicates that woody plants respond to severe hare browsing during the peak of the cycle by producing toxic metabolites and that this response may play a significant role in the regulation of the hare cycle.

Answers to the question of what drives the snowshoe hare cycle are far from uniform. Ecologists have been studying the cycle for more than fifty years, and most feel the problem has still not been satisfactorily resolved. Certain aspects of the cycle, however, are well established. Snowshoe hares have enormous potential for rapid increase in numbers (in favorable habitats, hundredfold increases have been recorded during a five-year period). At the low phase of the cycle, the hare population declines to vanishingly low numbers. In one area, for example, hare numbers were estimated at 2,000 per 100 hectares during the peak of the cycle and as low as 20 per 100 hectares at the crash. The period of the cycle may vary from region to region and from cycle to cycle (it ranges from 8 to 12 years, with about a 9.6 year mean), but within a region, hare populations rise and fall with a high degree of synchrony.

Many candidates for the mechanism that drives the cycle have been proposed—from weather patterns and cyclic wildfires to increased aggression among the crowded hares and increased predation and disease. Several of these theories provide partial answers, but until the recent work on the interactions of the hares and vegetation, I believe none has pinpointed the factors that trigger the decline or determine the period of the cycle.

Weather, for example, may perturb the cycle, and thus modify the amplitude of its oscillations, but it does not appear to cause it. Detailed studies have not revealed a simple, consistent relation between boreal forest weather patterns and the periodicity of the cycle.



The snowshoe hare gets its name from its large, hairy hind feet, which facilitate travel across snow. Its powerful hind legs enable the hare to flee from danger with long leaps and considerable speed.

Pat Powell, Aperture



Weather could drive the cycle indirectly. Lightning-caused fire is the single most important initiator of boreal forest succession, and early successional forests provide ideal hare habitat. Nearly fifty years ago, Wallace Grange, an early student of snowshoe hare ecology, suggested that the cycle is driven by cyclic wildfires, and there is evidence to support this theory. A strong correlation, for example, exists between the periodicity of wildfire in the Canadian boreal forest and the periodicity of Canada lynx pelt returns recorded by the Hudson's Bay Company.

The connection, however, is probably not as direct as Grange supposed. In western Alaska, the hare cycle is pronounced in riparian willow habitats, which are produced by spring flooding and ice scouring, but fire in the region is a relatively rare event and is probably not in phase with the hare cycle. Moreover, if a continent-wide fire cycle did exist, it could hardly provide the explanation for regional hare cycles that are often out of phase with each other. Nevertheless, there is no question that by creating large expanses of ideal hare habitat, fire strongly affects the potential for extreme expressions of the cycle. Flooding and insect outbreaks are other forms of disturbance that can set boreal forest succession in motion and thus provide the environment in which the hare cycle operates.

Population ecologists now generally agree that the hare cycle is density dependent, but they have widely divergent views as to what initiates the decline in the population once the number of hares per unit area in a region approaches some critical upper density. One school of thought holds that the hares have evolved intrinsic population regulation mechanisms driven by aggression. Increased aggression between hares at times of high density may lead either to psycho-physiological stress in the submissive animal, which causes failure of the adrenal gland and, ultimately, death or to dispersal of submissive individuals into habitats where the probability of survival is low.

Another school maintains that rather than controlling their own numbers, the hares are regulated by food shortages, disease, parasitism, predation, or some combination of such constraints. A model suggested by some ecologists predicts that an increase in hares is followed by an increase in hare predators—for example, Canada lynx, red fox, great horned owl, and goshawk—until the hare population can no longer withstand the predation rate and crashes. Following the disappearance of the hares, predators starve or emigrate to more rewarding hunting grounds. Released from intense predation, the hare population rebounds, and another oscillation of the cycle begins. Although appealing because of its biological and mathematical elegance, this model does not appear to be a sufficient account of the cycle's mechanism. Given the hares' tremendous capacity for population increase, even the combined toll of all their potential predators would be unlikely to contain an expanding hare population unless some more fundamental constraint had first initiated the decline. Increased predation, disease, and parasitism may aggravate the hares' decline, but they cannot cause it.

A more likely explanation seems to be that the decline phase is initiated when the hares destroy their preferred winter food, the twigs and bark of disturbance-adapted early successional trees and shrubs. The most fascinating aspect of the cycle, however, is, not that the hare population overshoots its food supply and subsequently crashes because of malnutrition, but the length of time—at least one hundred years and probably much longer—that the subarctic populations have exhibited an approximately ten-year periodicity.

Ecologists G. Evelyn Hutchinson of Yale University and Robert May of Princeton University have proposed that such cycles are a result of the delay with which species respond to changes in their populations or in the populations of interacting species. If an herbivore population, for example, is slow to adjust to a decline in the plant populations on which it feeds, it tends to overshoot the food supply and undergo a malnutrition-caused, overcompensatory crash. The extent of the crash and the speed of the recovery depend, in part, on just how long the delay is, relative to the periodicity of the cycle. Chaotic, violent oscillations, which can lead to the extinction of the herbivore, begin to occur if the delay is long enough. Shorter delays produce less extreme oscillations. When, for example, some property of the vegetation recovery process retards the recovery of the herbivore population for a length of time equivalent to one-fourth the period of the cycle, the oscillations will be marked enough to produce a severe crash of the herbivore population, but not so severe as to prevent the herbivore from rebuilding to its previous peak. Hutchinson and May propose that the rise and fall of the snowshoe hare is an example of this kind of cycle. According to this theory, since the period of the hare cycle ranges from eight to twelve years, the hares should take two to three years to respond to the recovery of the plants. My evidence suggests that this is the case.

What sort of mechanism could con-

W. E. Ruth, Bruce Coleman



At the peak of the ten-year snowshoe hare cycle, the woody plants preferred by the animals are overbrowsed. In response, the plants produce shoots unpalatable to the hares. The deterioration in the food supply appears to last long enough to cause a crash in the hare population.

W. E. Ruth



tinue to keep the hare population down once the vegetation begins to recover? To answer this question, my associates and I have been investigating the interactions between snowshoe hares and the woody plants of the boreal forests in which they live. Snowshoe hares, like all subarctic browsing mammals, reach high densities only in habitats that contain patches of early successional vegetation. While they do inhabit late successional black spruce (*Picea mariana*) forests and alder (*Alnus* spp.) thickets, hares are most abundant where both dense late successional vegetation and early successional plants are found. Within this mosaic environment, the hares use late successional vegetation primarily for shelter from severe winter storms and predators. They move once at dusk and once at dawn into the adjacent patches of early successional vegetation to feed on willows, birches, poplars, and jack pines, their preferred winter food. Unless they are starving, they feed lightly, if at all, on black spruce and green alder (*A. crispa*).

In controlled feeding experiments, hares can be maintained indefinitely under winter conditions if fed a diverse, highly palatable diet of the mature parts of early successional browse species. By contrast, they survive only a few days when fed nothing but alder and other, less palatable late successional woody plant species. Malnutrition is an unlikely cause of the hares' rapid deterioration. Alder is a nitrogen-fixing plant whose winter dormant twigs contain very high concentrations of nutritious proteins and soluble carbohydrates. Its chemical content would appear to make alder the most nutritious food available, yet it is one of the least-browsed subarctic woody plants. Why?

Knowing that black spruce and alder are noted for their high tissue concentrations of toxic secondary metabolites, I decided to test the possibility that snowshoe hares avoid feeding on late successional trees and shrubs because of the plants' toxicity. I extracted terpene and phenolic resins from both green alder and black spruce and incorporated the extracts into commercial hare food, which I then offered to both free-ranging and captive snowshoe hares. In all the feeding experiments, hares avoided the resin-treated food but eagerly ate the unadulterated control food. Moreover, captive hares that were offered only resin-treated food refused to eat for several days, and when hunger finally forced them to feed on the treated food, they lost weight even more rapidly than when they were eating nothing.

Subsequent experiments have begun to show why ingestion of these resins is so stressful to hares. Green alder resin contains relatively large quantities of pinosylvin methyl ether, a phenolic substance that appears to be repellent to hares and is known to be repellent and toxic to a variety of herbivores, from termites to rabbits. When wood that is normally heavily fed upon by tropical termites is treated with this substance—in quantities as low as one-tenth of one percent of the dry weight of the treated wood—the termites will not even approach the wood for at least two years.

The toxicity of these plants is partly a consequence of the conditions of extreme nutritional stress under which they grow. Many trees and shrubs adapted to growth on nutrient-deficient soils have slow turnover rates of twigs and leaves. Consequently, they experience less of the nutrient loss that accompanies the frequent shedding of leaves and twigs characteristic of woody plants adapted to growth on nutrient-rich soils. This nutritional conservatism, however, also means that a large fraction of the nutrient and carbon reserves of these plants is exposed year-round to above-



In winter, snowshoe hares seek protection from storms and predators beneath snow-laden, late successional trees such as spruce. For feeding, they prefer early successional species, including willow and birch.

Mario Grassi, AlaskaPhoto

ground herbivory and that the plants have limited ability to replace parts eaten by herbivores. Real or simulated hare browsing of late successional boreal forest trees and shrubs greatly reduces their reproductive output and results in high mortality levels. That these plants have evolved chemical defenses against herbivores is therefore not surprising.

Late successional trees and shrubs are not the only woody plants of the boreal forest that are toxic to snowshoe hares. Plant chemical defenses also play a crucial role in the interactions between early successional woody plants and hares but in a very different way. This difference may provide part of the explanation of the hare cycle.

During the winter of 1972–73, hare numbers around Fairbanks peaked and started to decline. David Klein of the Alaska Cooperative Wildlife Research Unit noticed that hares fed heavily that winter on mature early successional trees and shrubs but appeared to avoid the adventitious shoots, or stump sprouts, being regenerated by these preferred browse species. Furthermore, the avoidance seemed to be even stronger than the avoidance of black spruce twigs, which at this point in the cycle made up much of the diet of the declining hare population. Klein speculated that adventitious shoots were avoided either because they contained few nutrients or because they were toxic. To test these alternatives, he first confirmed experimentally that when equal quantities of both adventitious shoots and small-diameter, mature twigs of willows, poplars, and birches were available, the hares shunned the shoots but eagerly fed on the twigs. He then assayed the nutritional content of the twigs and shoots and found that the shoots had higher tissue concentrations of nutritional chemicals. Their apparent low palatability, Klein hypothesized, must be a result of their toxicity.



This startling experiment suggested to me that the browsing caused a defensive response in the hares' preferred browse species. Observations I had made about the relationship between Alaska paper birch (*Betula papyrifera* spp. *humilis*) and snowshoe hares supported this hypothesis. Alaska paper birch is a member of a group of birches characterized by an abundance of toxic resin glands in the one-year-old twigs of adventitious shoots and an absence of resin glands in the one-year-old twigs of mature plants. The foliar buds of both kinds of twigs contain high concentrations of resins. When hares feed upon the mature-plant twigs, they reject only the buds; when feeding upon the stump-sprout twigs, they reject the entire twig. Hares are the only herbivores I know of that exhibit such feeding behavior. I suggested that resins known to protect birch foliar buds against insects are extended to the twigs of adventitious shoots when the risk of hare attack is high. Subsequent experiments have shown that such an extension of chemical defenses is also characteristic of the highly preferred poplars and the much less palatable alders.

Many juvenile woody plants produce thorns or large quantities of toxic secondary compounds, which appear to deter herbivory. The highly complex controls over the progression from juvenility to maturity are far from clearly understood, but plant physiologists do know that in deciduous woody plants, the progression is reversible: severe pruning can cause a mature plant to revert to a juvenile form. As a part of the reversion, the plant will increase its production of defensive structures and substances. Since the hares' intense browsing of their preferred plants at the peak phase of the cycle is nothing more than severe pruning, reversion to juvenility may provide the physiological explanation for the defensive response turned up in Klein's experiments.

Such an induced defense appears to fit well into the overall adaptive strategy of early successional, disturbance-tolerant trees and shrubs. These plants store relatively large carbon and nutrient reserves in underground parts, such as roots, from which they can regenerate

Charlie Ott, Photo Researchers



Canada lynx and other predators can take a heavy toll of snowshoe hares. The hares' capacity to increase in number is enormous, however, and predation alone cannot cause the cyclic crash of the hare population.

aboveground parts destroyed by disturbance. Hare browsing can be viewed as a form of disturbance, so why, one might ask, do the plants respond to intense browsing by becoming toxic? The answer lies in another aspect of adaptation to growth on recently disturbed sites. A severe disturbance to a late successional ecosystem—wildfire, for example—opens up the forest canopy and releases large quantities of nutrients from the living and the dead vegetation. Early successional trees and shrubs then compete for the nutrients and the light to gain dominance in the opening and reach the forest canopy.

At this stage in their development, these juvenile browse species need to grow upward quickly, so they allocate much of their carbon to vertical growth and chemical defense against hare browsing; once out of reach of hares, they allocate more carbon to lateral development of the crown and production of seeds and less to chemical defense and vertical growth. In the event of intense browsing, however, plants can—by reverting to juvenile form—increase the allocation of carbon to defense. Without this ability, repeated regeneration of leaves and twigs at times of heavy browsing might stress the underground carbon reserves so severely that the plant could no longer respond defensively to browsing or compete successfully with other plants.

To the hare, the defensive response of its preferred browse species means a serious deterioration in the nutritional quality of its winter food supply. My experiments strongly suggest that this deterioration lasts for two to three years—the time lag predicted by the Hutchinson-May model of the hare cycle—even though only the one-year-old twigs of adventitious shoots appear to be highly repellent to hares.

The first year after heavy browsing, all the new twigs produced by these early successional woody plants are chemically defended and of little nutritive value to hares. Adventitious shoots grow rapidly, and in the second year of growth after browsing, the two-year-old twigs are no longer toxic, but they are usually more than 4 mm in diameter and have very high wood/bark ratios. Since most of the nutrients of the twig are stored in the inner bark, a high wood/bark ratio is associated with low nutrition irrespective of toxicity; these twigs are also essentially useless to the hares. The only small-diameter twigs available during this second year are one year old and thus chemically defended. In the third year of growth, however, a few lateral branches support a modest number of small-diameter, two-year-old twigs that hares can feed on efficiently. After three years, this usable biomass increases rapidly, and the hare population can begin its recovery.

In the end, then, the cycle may be a consequence of the adaptation of boreal trees and shrubs to disturbance, and particularly to fire, but the fire–succession–hare connection seems to be tied more closely to the behavior of the plants themselves than was previously realized. The plants' ability to produce toxins—an ability so advantageous to them and so devastating to the hares—may occupy a pivotal place in the almost legendary ten-year population cycle of the snowshoe hare. □

Ralph H. Williams, Bruce Coleman





In Praise of Plains

Early explorers told of being overwhelmed by the silence and vastness of the grasslands

by Marilyn Coffey



"I drink the wind like wine."
Hamlin Garland

The Great Plains region of the United States, where I was born and raised, is part of an enormous strip of flatland that stretches alongside the Rocky Mountain chain for more than three thousand miles, from the plateaus of northern Mexico to the Mackenzie River in subarctic Canada. In sheer extent, this North American grassland has no equal on earth although similar areas exist on other continents: the steppes of Siberia, the pampas of South America, the veldts of Africa. Shaped roughly like the crescent of the waxing moon, the Great Plains swells to its maximum in central United States, tapers to near points at its termini. Once, not much more than a hundred years ago, this plain was nothing but meadow, a tangled profusion of grasses and wildflowers broken only by an occasional tree-lined river or stream meandering slowly downslope or by buffalo and Indian trails, which crisscrossed each other in an intricate network that led from waterway to waterway.

I never actually laid eyes on virgin prairie when I was young. Except for scattered fragments, some of which can still be seen today, virtually all of the native grassland of the central plains had been plowed under long before I was born. In fact, my great-grandfathers James Thomas Coffey and Isaac Matts Smith were two of the hundreds of small farmers who resolutely overturned the sod, Smith in 1883 and Coffey in 1885, burying the last generation of native meadow deep in the Tertiary soil out of which its ancestors had sprung millions of years ago. But that didn't matter to me. I knew how the prairie must have been, not because I had been told, but because some vestige of it seemed to cling to me, as though knowledge of

A storm sweeps across the Plains.
Jim Brandenburg

what the land had once been entered me through my very pores, carried, perhaps, by the ceaseless wind. It was, paradoxically, the most beautiful land I had ever seen.

Reports of the virgin prairie's beauty, written by early explorers and naturalists, confirm my childhood intuition. Journal entry after entry describes the vast meadows as profusely decorated—"gilded"—with myriad flowers. The fields of Quivira, in central Kansas, were "covered with flowers of a thousand different kinds, so thick that they choked the pasture," wrote the Spanish explorer Oñate in 1601. "A thousand young flowers gemmed the grassy plains," wrote Thomas J. Farnham some two hundred years later. There were the sky blue flowers of spiderwort and the light red phlox, the "showy" yellow sunflowers and purple asters, fields full of white flowers and long garlands of wild roses, whose single corolla of pale pink petals surrounded a chunky golden stamen and whose fragrance lay heavy in the early spring air. "These vast plains, beautiful almost as the fancied Elysium, were enamelled with innumerable flowers," wrote English botanist Thomas Nuttall in 1819, "an uncommon variety of flowers of vivid tints, possessing all the brilliancy of tropical productions."

As profuse and varied as the flowers, although less spectacular, were the grasses, which ranged in height from the short stubby buffalo and grama grasses of the semiarid western prairie through the thick luxuriant mixed grasses of the subhumid central prairie, about ten inches high, to the great swaying blades of bluestem and Indian grass in the humid eastern prairie, blades that rose eight feet high. These heights were directly proportional to the rainfall, which tapers off from east to west, as can be seen today by the commercial grasses that have replaced the native strains. In the east, corn, a grass, rustles higher than a man's head, while the less humid central region is renowned for another, shorter grass: winter wheat. The semiarid western prairie, then as now, was good primarily for grazing, its clumps of short grass mixing with prickly pear and with the sunflower: a tiny wildflower in the west, taller than a tulip in the central plains, and eight feet high in the east. The central plains, where I grew up, was a transitional area, dependent on the intermittent rain that never seemed to fall twice in the same place. In dry years, needlegrass and other short



Tom McHugh, Photo Researchers





Winter's blizzards, above, give way to spring's wildflowers, left.

grasses from the west would intrude to mix with the central prairie's June grass and wheat grass at the top of sunbaked ravines; in wetter years, bluestem would creep in from the east, taking hold along moisture-laden ravine bottoms.

This stunning panorama of wildflowers and native grasses, their species described meticulously by early botanists, would probably strike the modern eye as one vast impressionistic canvas swept by variegated colors that changed with the prairie's moods. How delicate this meadow must have appeared in the blue light of an early morning, as bland morning breezes bent the tips of grasses, displaying the muted colors of the blades' undersides. How vivid at midday, the sky as clear as in a Chinese painting, when through the crystal light, according to artist Thomas Mails, you could see a spot of color twenty miles away. Or after a shower when, according to Maj. Stephen Harriman Long, the grass was "gemmed with the reflection of innumerable pendant raindrops." And how serene under the purple light of a calm evening, when deer might be seen stepping through the shoals that separated sandbars on a meandering river like the Platte: a "stilly scene, like shadows of phantasmagoria, or Ossian's deer made of mist," wrote Henry Marie Brackenridge.

Not only did colors shift with the various moods of each prairie day but also with each season: white in winter, green in spring, yellow in summer, and red-orange in autumn, says Mails. But that simplifies the matter too much in a land where winter may look like a mirror as a sudden drenching of February rain turns the Plains into a continuous sheet of water. Or brown, as snow melts to reveal the stubborn remnants of the prairie grass, some of which live for twenty years. In early spring, the slender shoots of bright new grass may well sprout up a sharp and tender green in the winter-yellowed sward. But spring and autumn are when the wildflowers reach their peak of intensity, glazing the meadow with purples, pinks, red, yellow, and white. In the overplus of August's brittle light, sere stubble may suddenly mirage into an islanded lake, while through the October haze of a reddened Indian summer sun, the prairie colors are seen as though wrapped in smoke.

The beauty of the Great Plains, however, was not for everyone. The space I took for granted as a child, what the Plains Indians called the *waho*—the great circle of the horizon—was more than most newcomers, whose ideas of space had been formed in hilly, tree-studded country, could bear. "The first experience of the plains, like the first sail with a 'cap' full of wind, is apt to be sickening," wrote an early viewer, Colonel Dodge. More than one journeyer, in diary or letter, told of standing still and lonely, overwhelmed by the silence and vastness of the place. "Magnificent, though melancholy," wrote Henry Brackenridge in 1811, while Thomas Farnham noted, in 1839, that his eyes ached from his attempts to embrace the view. More than one writer mentioned a general feeling of emptiness or dwelt on their "nauseating" loneliness. Even Coronado, who must have been reminded of portions of his native Spain when he entered this dry, treeless land, expressed surprise at its scope, saying, "I came upon some plains so vast that in my travels I did not reach their end, although I marched over them for more than three hundred leagues"—nearly one thousand miles, as we measure land.

The Plains were most frequently compared, by early journal writers, to an ocean, an ocean where one swell melted imperceptibly into another. Some, like expedition leader Wilson P. Hunt, used this figure of speech literally. "The limits of the visible horizon," wrote Hunt, "are as exactly defined, and the view as extensive as at sea, the undulations on the surface of the earth here bearing no greater proportion in scale than the

Tom McHugh, Photo Researchers

Brian Milne



David Barnes, Photo Researchers



Above: Rabbit is obscured by grass. Right: Road divides plowed fields.

waves of an agitated ocean." Others were more poetic. Thomas Farnham called the Plains "vast savannahs, resembling molten seas of emerald sparkling with flowers, arrested while stormy and heaving, and fixed in eternal repose." Adopting a more tragic perspective, Abbe Emmanuel H. Domenech wrote, in 1860, that the grasslands of west Texas were "like an ocean of dark stunted herbs, in which not a single bush or bramble obstructed the view, where nothing marked a beginning or an end, and where all was mute and motionless." Some, like the young American Brackenridge, found the ocean comparison inadequate. "If the vast expanse of the ocean is considered a sublime spectacle," he wrote of the central plains in 1811, "this is even more so; for the eye has still greater scope." Or, as Hamlin Garland would put it decades later, "my eyes/Fasten on more of earth and air/ Than seashores furnish anywhere."

Those to whom the vast open space was not oppressive found it, as I did, exhilarating. "The nerves stiffen, the senses expand, and man begins to realize the magnificence of being," wrote Colonel Dodge, once he'd recovered from his seasickness. Brackenridge, who had stepped out onto the Plains from a riverboat on the Missouri, wrote: "Instead of being closed up in a moving prison, deprived of the use of our limbs, here we may wander at will. The mind naturally expands, or contracts, to suit the sphere in which it exists—in the immeasurable immensity of the scene, the intellectual faculties are endued with an energy, a vigor, a spring, not to be described."

Exhilaration, however, could tip quickly into terror, and often did, particularly when unprepared travelers first met the Great Plains thunderbird, that spectacular mythological creature that flies through the air with its eyes closed, its gigantic wings flapping out "peals of thunder which seemed to shake the earth to its center," thunder that visibly enraged the buffalo bulls that pawed the earth and bellowed as the big bird rumbled overhead. When the thunderbird blinked, the Indians said, great spears of sprangling lightning would flash out of its open eyes, leaving the pack animals to huddle abjectly together, heads drooping and limbs stilled, while humans trembled for their lives.

The Great Plains is justifiably famous for its violent thunderstorms, one of the more dramatic aspects of the region's changeable, highly versatile weather. The storms, typically of short duration, often produce downpours of three to six inches or more. The rain tends to be local, drenching the earth in one spot while the surrounding area remains dry. Most thunderstorms are caused when two of the region's three major air masses collide, when the cold dry air from Canada strikes either warm, moisture-laden air masses from the Gulf of Mexico or air that has swept across the Rocky Mountains, Pacific air masses that range from warm to cold, moist to dry. Most rain falls from April to July, with storms reaching their maximum in May or June, the months when most early travelers began their long treks into, or across, the Plains. As a result, early journals abound with tales of travelers drenched to their skins, spending cold, sleepless, wet nights, unable to find a bit of dry bedding or clothing among all their gear. Along the Platte River, famous for drawing thunderstorms, emigrants reported almost daily downpours in the spring of 1839.

Anyone who has seen a Great Plains thunderstorm in its full splendor knows that its most spectacular feature, the thing that distinguishes it most clearly from an equally violent downpour in the city, is that the storm can be seen coming from miles away. Indeed, the Plains area is so large that a storm, from a distance, can be perceived as a single entity, its black clouds churning, its



lightning jets leaping, its gray sheet of rain falling in a slanting torrent even while the sun shines directly overhead. Before the storm is seen, it can be heard, its thunder rumbling gently from a great distance. And before it can be heard, it can be felt—a shift in the temperature of the air, a certain silencing of the wind. "Excepting the sound of distant thunder, which was continual," wrote English naturalist John Bradbury of a prairie storm in May 1810, "an awful silence prevailed, and the cloud which had already spread over one half of the visible horizon was fast shutting out the little remains of daylight." As the cloud drew overhead, he noted that it was of "a pitchy blackness, and so dense as to resemble a solid body, out of which, at short intervals, the lightning poured in a continual stream for one or two seconds. Darkness came on with a rapidity I never before witnessed." He wrapped himself in a blanket and lay down on the open land. "The lightning," recorded Farnham of a storm in 1839, "was intensely vivid," as three black clouds, one in the southeast, one in the southwest, and one in the northeast, "rose with an awful rapidity towards the zenith." As he looked up, he saw the cloud "rent in fragments, by the most terrific explosion of electricity we had ever witnessed." Peals of thunder followed, as burning bolts leaped from cloud to cloud, enveloping the land in a "lurid glare."

Hail often accompanied these storms, although, curiously, the size of hailstones seems to diminish with the passing of time. In 1541 one of Coronado's conquistadors, Pedro de Castañeda of Náxera, reported hail in the southern plains "as large as bowls and even larger, and as thick as raindrops, that in places they covered the ground to the depth of two and three and even more spans." The huge stones destroyed the Spaniards' tents, dented their armor, bruised their horses, and broke all their pottery, a problem for the Spanish army since the local Indians, who ate only fruit and meat, had no use for crockery and could supply them with none. Many years later on the Plains, a report circulated of an Indian who had been knocked down by a hailstone the size of a goose egg. As for myself, although I stood on our screened-in back porch through many a summer storm with my father, a farm boy who never tired of watching it rain, and saw countless white stones fall from the sky and bounce across our green lawn, I cannot

say that I ever saw a prairie hailstone larger than a marble, although some were as big as taws. However, the folks over at Republican City swore they had seen hail the size of ping-pong balls, and they had cars with bashed-in windshields to prove it.

Less dramatic than the storms, but equally unnerving—at least for some—was the prairie's *trompe l'oeil*. Optical illusions, caused by the combination of a rarified, transparent atmosphere with distances so great that "only the curvature of the earth's surface limits the view," often fooled the eye of the inexperienced observer. Objects, which could be seen with remarkable clarity from a great distance, became strangely distorted. Some were magnified, so that a raven might be mistaken for an Indian or an antelope for the much larger elk. Some were diminished, so that the leafy tops of the line of timber along a distant river seemed to "wave and mingle among the grass of the wild swelling meadows." Some objects, such as tufts of grass or buffalo bones, were elevated, stretching up so high that they looked like humans. The first to mention this phenomenon was one of Coronado's chroniclers, who wrote that the land where buffalo roamed was "so level and bare that whenever one looked at them, one could see the sky between their legs, so that at distance they looked like trimmed pine tree trunks with foliage joining at the top." Sometimes, under the intense glare of a pitiless August sun, the "earth and sky seemed to blend." In its most extreme form, this illusion became a mirage, such as the one described in 1849 by Alonzo Delano: "The glare of the sun upon the distant plain resembled the waves of a sea, and there were appearances of islands and groves."

This "abnormal land" was home to me. As I was growing up, I knew no other world but the prairie's vast *waho*, its thunderstorms, its windblown fields. This natural habitat would render agoraphobia—the fear of open spaces—as incomprehensible to me as, many years later, my claustrophobia when ringed in by mountains or trees was to those who judged such restrictions "natural." Like a medieval woman, I was limited by the world I knew but knew not that my world was limited. □



Great Plains wheatfield.

Craig Aurness



A Least Tern Makes a Right Turn

With a little help from the Endangered Species Act, an imperiled California bird is on the road to recovery

by Barbara W. Massey

Photographs by George D. Lepp

One endangered animal that seems to have a good chance for survival is the California least tern (*Sterna albifrons browni*). This feisty bird, the smallest of its genus, is making a comeback, thanks to strong protective efforts on its behalf. The California least tern is one of three subspecies of *S. albifrons* that breed in the United States. On the eastern seaboard *S. a. antillarum* nests on beaches from Maine to Florida, its breeding biology very similar to the California least tern. An inland race, the interior least tern (*S. a. athalassos*) nests on sandbars in rivers of the Mississippi drainage system. The west coast birds breed from



San Francisco Bay to the tip of Baja California. All three subspecies are beset by problems, mostly due to loss of habitat, but thus far only the California least tern has been listed as endangered.

The California least tern has traditionally nested on beaches and salt flats adjacent to estuaries, feeding on small fish taken from a wide range of habitats—estuaries, open ocean, rivers, and lakes. The terns usually arrive in California in mid- or late April, and for several weeks engage in aerial courtship. One frequently observed aerial display is the fish flight, initiated by a male carrying a small fish and calling as he flies. He is joined by one and sometimes two other least terns (presumably females) for some fast and vocal high flying. Another spectacular display is the aerial glide—formation flying by a pair that rise high in a weaving pattern and then soar downward in unison in a beautiful glide. At night the terns congregate at roosting sites on beaches, using the same locations year after year. The ground phase follows aerial courtship and is characterized by acts that help cement the pair bond, with courtship feeding of females by their mates one of the most important rituals. Copulation is frequent at this stage. The male

Undaunted by the proximity of sunbathers, California least terns loaf on the beach in Venice, California. Developed extensively in recent decades, this coastal community was a tern nesting site until human disturbance finally drove the birds off the beach in the early 1960s. When 35 pairs reestablished a colony in 1977, however, protective fencing was quickly erected around the nesting area. About 150 pairs nested on the beach in 1980, making the colony the largest in the state.





often holds a fish in his bill throughout the precopulatory sequence, and the female reaches up and takes it from him at the moment of cloacal contact.

As the time for egg laying approaches, the pair begin to look for the particular spot where the nest will be scraped in the sand. They engage in elaborate scrape making, moving from place to place until the female finally selects a site to her liking and scrapes out a simple hollow for the eggs. From one to three eggs (usually two) are laid on consecutive days, after which both adults take turns at incubation duties.

The relative serenity of the incubation period is the lull before the storm. After about three weeks, the eggs hatch and the tempo quickens. The precocial chicks begin wandering away from the nest scrape a day or two after hatching. Their diet consists solely of small fish brought to them by both parents. Parents only feed their own chicks, and the chicks learn to respond only to the calls of their parents as they fly in with fish. Since the chicks are extremely mobile, and a colony of a hundred pairs of California least terns can have 200 chicks running around simultaneously, the communication system must be firmly established on the first posthatching day. The chicks are on the ground for about twenty days after hatching, eating voraciously and growing rapidly until they are mature enough to fly. During both the incubation and posthatching periods, the colony is extremely vulnerable, and eggs and chicks are regularly lost to ground and aerial predators. Disturbance by people can also have serious consequences during this time as the presence of intruders on the nesting grounds keeps adults off their eggs or away from their chicks. Once the chicks are airborne, the hazards diminish.

After fledging, the juveniles begin to fish for their own food, practicing in local ponds and still-water bays. It takes a lot of practice before they acquire the skills necessary to feed themselves, so parents continue to feed their young long after they have fledged. At dusk, adults and juveniles congregate at roosting sites on the beaches where they spend the night. These roosting areas and postbreeding fishing sites play an important role in the life history of the least tern, and must be protected along with the more obvious nest sites and adult fishing grounds. By August the nesting season is usually over and migration to wintering areas has begun. Family groups are maintained during migration, and adults can be seen feeding juveniles at fishing and loafing areas en route.

The least terns' predilection for nesting on beaches and foraging in estuaries was the major cause of their drastic decline in numbers. The tremendous growth of the human population in California after World War II, particularly along the southern coast, put pressures on the birds that they could not withstand. In terms of breeding habitat, undisturbed beaches became scarce and most of California's estuaries were dredged and converted into marinas. Colonies that once numbered hundreds of pairs were reduced to remnants or vanished altogether. But the terns showed remarkable adaptability and ingenuity in finding substitute nest sites;



As this least tern emerged from the egg, the first moments of its life were captured by the photographer. The chick's cryptic coloration provides a defense against predators.





In a sequence of courtship and mating, a male approaches a female with a fish. After much head moving and wing fluttering, the male mounts the female. During copulation the female reaches up and takes the fish.

they have nested successfully between runways on airports, on parking lots and freeway cloverleafs, and on an abandoned trash dump, to name just a few. Adaptability notwithstanding, the least tern was fighting a losing battle in southern California as coastal lands were relentlessly developed and would not have been around much longer if drastic steps had not been taken.

The passage of the federal Endangered Species Act in 1969 began a reversal of the downward spiral. The act covered not only species of endangered animals (for example, the California condor, *Gymnogyps californianus,* but also subspecies that were in jeopardy). California quickly passed its own act, and finally, there was legislation that could be used to assist beleaguered animals such as the California least tern. A list of endangered species and subspecies was drawn up by the U.S. Fish and Wildlife Service, the state of California followed with its own list, and the California least tern was on both lists.

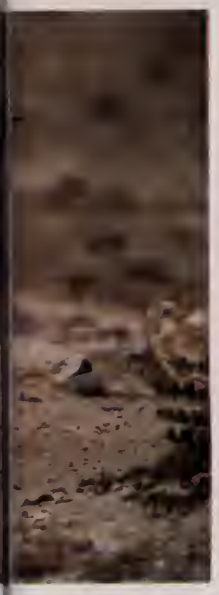
My involvement with the birds began at this time. I was a middle-aged returnee to graduate school at California State University, Long Beach, retraining to become a field biologist. For a master's thesis project, I wished to do a field study, and my adviser, ornithologist Charles T. Collins, suggested the California least tern. It had just been listed as endangered, but there was almost no information on its breeding biology and, thus, no guidelines as to how to protect it. Several local breeding colonies made daily observations feasible. My commitment to the terns, in retrospect, was instant and total.

In 1971 the California Department of Fish and Game began to protect the birds during the breeding season and to fund some preliminary studies. A survey of nesting sites was made in 1971, and in 1973 the first statewide census was taken. The passage of the California Coastal Zone Act in 1972 resulted in the creation of regional commissions to monitor development along the coast and a statewide commission to hear appeals. The California Coastal Plan, written by the staffs of both the local and state commissions, was approved by the state legislature in 1976. A priority item in the plan is the preservation and restoration of coastal wetlands. Since its inception, the state commission has taken a strong stand on protection of coastal wetlands and endangered species and has supported all efforts made on behalf of the least tern.

The Endangered Species Act was much strengthened by Congress in 1973, and one of the results of the amended act was the formation of a recovery team to watch over the California least tern. Since 1974, the team has played a vital role in the turnaround in the fortunes of the tern (it is almost impossible to write about terns without at least one play on words). The team was charged with writing a recovery plan spelling out the procedures necessary to insure the survival of this endangered bird. One of the most important aspects of the plan was the delineation of habitats considered essential for successful breeding. Included were nest sites, fishing areas, loafing spots, night roosts—any place that was of importance in the breeding cycle and was in regular use by the birds during some part of their stay in California. The plan was completed in 1977 and approved by the U.S. Fish and Wildlife Service in 1980.

Protection of the terns' habitat is the core of the recovery plan. Currently, there are about a dozen nest sites under the protective aegis of a federal, state, or other public agency; the plan recommends secure nest sites in "at least twenty coastal wetlands ecosystems" throughout the birds' range. An annual census of the breeding population, surveillance of all colonies during the nesting season to spot and correct problems as they arise, creation of new nesting sites, research programs to learn more about the birds' breeding biology, exploration of Baja California during the spring to identify the rest of the breeding range, and exploration of the west coasts of Mexico and Central America to determine the wintering range are all aspects of the plan that have been implemented in varying degrees.

Since the first breeding census in 1973, the population has been monitored annually with funds made possible by the Endangered Species Act. About six hundred pairs were estimated in 1973 and for the next three years that figure remained stable. In 1977 there was a modest increase of about fifty







pairs and we were hopeful, but reserved judgment. Censusing techniques had improved, new colonies were being found, and the increase might simply reflect these factors and not be real. But the figures kept climbing in 1978 and 1979, and by 1980 more than nine hundred breeding pairs were counted. It is hearteningly apparent that protective measures are working.

With the increase in population came a need for new nesting areas. Creation of nest sites is an idea still in its youth, but decidedly past infancy. After several attempts that failed, but from which important information was obtained, two successful sites were created on islands in salt marshes in northern Orange County. They were used by the terns in 1979, 1980, and 1981. In all cases, the beaches associated with the salt marshes were heavily peopled during the summer months and no least terns had nested on them for more than thirty years. One of the sites was an existing landfill in the Seal Beach National Wildlife Refuge in Anaheim Bay, connected by a narrow causeway to the mainland. The rough surface of the island was leveled and topped with sand, and pairs of papier-mâché decoys were scattered about. One of life's more satisfying moments occurred when I saw a least tern land and offer a fish to a decoy. Soon there was a small group of nesting birds, and in early June 1979 the first chicks hatched. But as the season advanced, predators began to take a heavy toll of the chicks. By the end of the season the refuge managers knew that predator control was mandatory. In 1980, about a month before the terns were due to arrive, live traps were set around the island and twenty-nine skunks, five feral cats, three red fox, and two opossum were removed from the area, indicating the magnitude of the problem. An electric fence was then installed across the causeway. The measures proved reasonably effective against ground predators but no defense at all against birds of prey (American kestrels, burrowing owls, crows). Even though predation was a continuing problem, forty-three pairs of terns nested in Anaheim Bay in 1980 and produced a respectable number of fledglings.

At Venice Beach in Los Angeles another success story has unfolded during the past few years. In 1977, a resident of this beach-front community reported to the California Department of Fish and Game that several least terns nesting on the beach were being molested by dogs and people. Venice Beach is at the mouth of a former estuary, now almost totally channelized and converted into a marina. Once the site of a large nesting colony and now a heavily used bathing beach, Venice had not been used by the terns since the early 1960s. Concerted action by several agencies, prodded by concerned citizens of Venice, resulted in the erection of protective fencing around the few hardy pairs that were attempting to nest on the beach. The birds' response was immediate, and by the end of the 1977 season there were 35 pairs. The terns came back and nesting was successful the following year. (It has been our experience that if the terns succeed in hatching chicks they will usually return the next year, even if none of the chicks survive to fledge.) The colony has grown with giant steps

A male presents the small fish he has caught to his mate sitting in a nest scrape, below. The adult bird, right, is incubating a clutch of eggs at a nesting site on the coast of California.





each season, and in 1980 about 150 pairs nested in the fenced sanctuary, making it the largest in the state. An estimated 240 fledglings joined the migratory flock at the end of the season. The successful reestablishment of the Venice colony is an encouraging sign that there eventually may be California least terns nesting all along the coast on beaches from which they were extirpated.

Proper management of an endangered species must be based on a thorough knowledge of its life history. At the same time, the study of an endangered species must proceed with extreme caution in order not to jeopardize the subject one is trying to protect. Breeding California least terns do not tolerate more than a minimum amount of handling, and our research has been tailored to their needs. In 1976, we embarked on a long-term study based on color banding of chicks. The banding is done under the auspices of recovery team member Charles T. Collins, and my colleague on this project is Jon Atwood, a doctoral candidate in biology at UCLA. We have found that a group of three to five experienced people can move through a large colony in the early morning and collect growth data and color band about fifty chicks an hour, after which the colony is left to return to its daily routine. There have been no untoward effects from this procedure.

We have banded more than 2,000 chicks since 1976, and since 1978 have color coded youngsters so that many returning adults can be identified in the field as to age and natal colony. We now spend many hours during the nesting season in a blind looking for and trapping banded birds. The information being sought through banding includes age of first breeding, tenacity of the pair bond, duration of breeding life, intercolony movements, postseason wandering, and where the birds go for the winter. Data on returning birds are accumulating at an accelerated pace each year. We have learned that the terns begin breeding at the age of two; these young birds arrive on the nesting grounds about six weeks after the older, experienced breeders, and lay their eggs after the first wave of chicks has already hatched. None of the larger terns of the genus *Sterna* breeds regularly at such an early age, and this finding was quite unexpected. When the adults return for the first time to breed, they do not necessarily come back to their natal colony. Once they have bred successfully at a site, however, they show a marked tendency to return the following year.

Information on pair bonds is, at this stage, ambiguous. Pairs apparently remain together throughout a season, as evidenced by banded pairs renesting after the loss of eggs or chicks. But the tenacity of the pair bond from season to season varies. Some birds return annually to the same spot in a breeding colony with the same mate; others have returned to the same or a different colony with another mate. One pair of banded birds "divorced" after a year, and the following season each nested with a new mate within fifteen feet of its previous territory.

The question of where California least terns spend the winter is one of the most challenging aspects of our research.

When Jon Atwood and I organized a group to look for wintering areas in December 1978, our only sure knowledge was that the terns went south of the California border, as there were no wintering records in the United States. At that time there had been no banding recoveries outside the United States and we had no clues as to where to begin our search. (There has since been one recov-



Two- to three-day-old chicks are fed by their parents. Because the chicks have successfully hatched, the adult pair will return to the same nesting area next year, whether or not these young survive to fledge.

ery from Guatemala.) We decided to start at Guaymas on the northwest coast of mainland Mexico and work south, spot-checking estuaries all the way to Chiapas. On our first trip we saw no least terns at all. The following winter Alan Craig of California's Department of Fish and Game, and head of the recovery team, visited some of the areas we had not been able to cover and found a group of seventy-five least terns at an estuary in Colima, south of the city of Manzanillo. The terns, unfortunately, could not be approached closely enough for bands to be detected.

In January 1981 we headed south once again, this time to concentrate on the Colima coast. We found a small number of wintering least terns at three estuaries south of Manzanillo. Several of the birds were banded, and one memorable morning we saw a color-banded bird at Boca de Pescuales. It was identifiable, thanks to color coding, as a California least tern, banded as a chick at Huntington Beach State Park in Orange County in 1979.

Colima appears to be the northern limit of the birds' wintering range, but we have yet to identify the major wintering area, as we saw only twenty to thirty wintering least terns in Colima. Much of the coast of southern Mexico has not been searched, and the recovery of one bird from Guatemala suggests that the wintering range may extend south along the coast of Central America.

Our interest in finding the wintering grounds is more than academic. The birds are being protected in California during the nesting season, but two-thirds of their year is spent elsewhere, under conditions about which we know nothing. If we are to be effective in protecting this migratory bird, we must know its entire life history, not just the segment that takes place on our shores.

The goal of the recovery plan for the California least tern is to restore the breeding population to 1,200 pairs, or double the number in existence when the bird was first listed as endangered. With continued protection and the creation of additional nesting sites, that goal could be reached within five years. If at that time there are viable breeding colonies in at least twenty different coastal wetlands, all permanently protected, the birds' recovery will have been accomplished, and it can then be considered for removal from the endangered species list. That will be cause for celebration. □



Weathering Heights

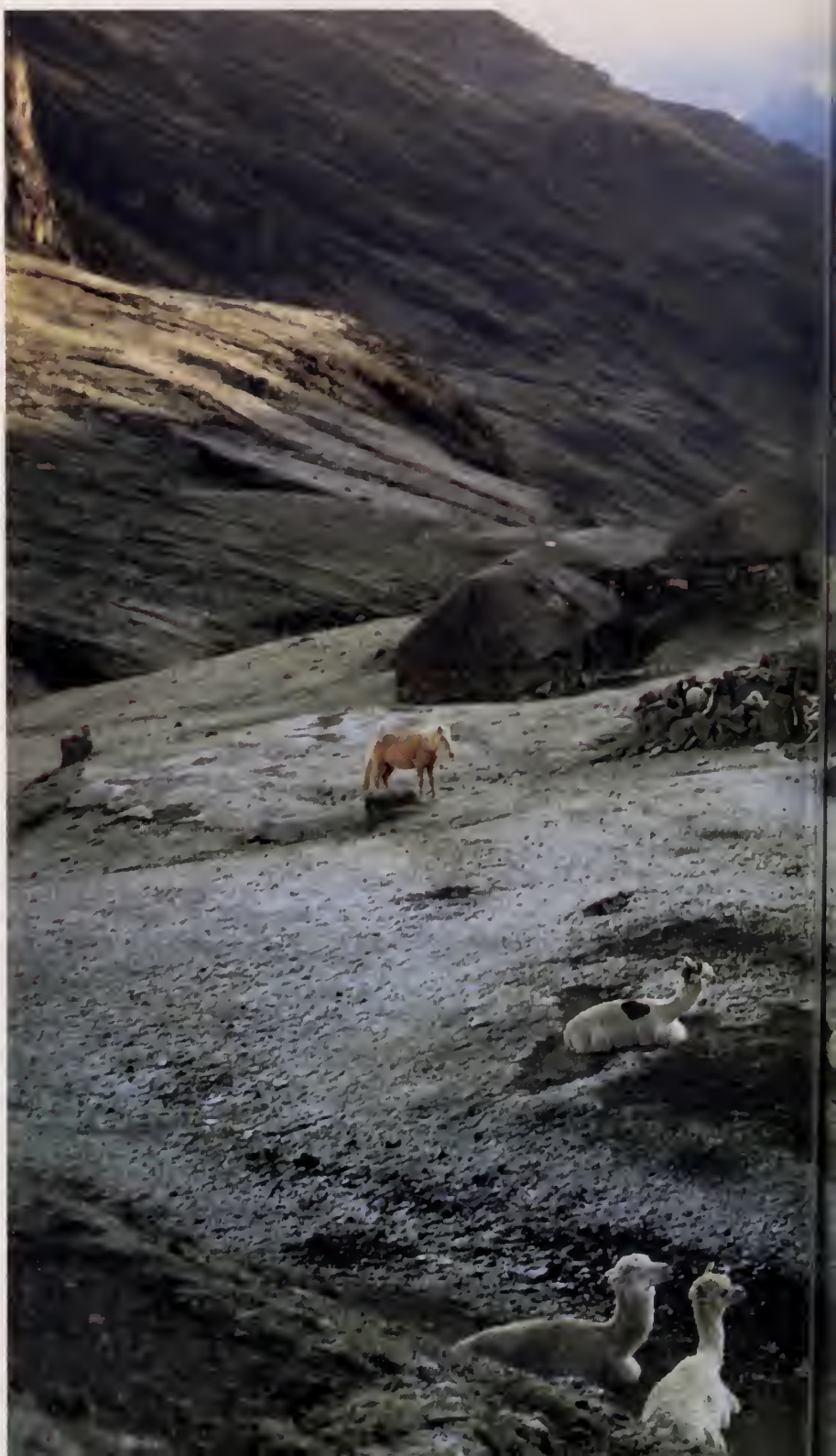
People who live high in the Andes and Himalayas have adapted both culturally and biologically to their environment

by Charles A. Weitz

The special problems of life at high altitude have intrigued Westerners since at least the time of the Spanish conquest of the Incas. Throughout Francisco Pizarro's campaigns in the highlands, horses collapsed from exertion and soldiers suffered from mountain sickness. Later, Spanish colonists experienced altitude-induced infertility, and eventually, most Europeans settled in lowland areas near the coast. In recent years, biological anthropologists and environmental physiologists have studied the relatively large native populations that live above 10,000 feet in South America and Central Asia in order to learn how these people cope, culturally and biologically, with the stresses imposed by their environment.

There are three main forms of stress at high altitude: restricted food resources, cold, and—most severe of all—a reduction in the amount of oxygen reaching body tissues. This last phenomenon, called hypoxia, is caused by low atmospheric pressure, which unless compensated for, reduces the amount of oxygen that diffuses through the lungs and into the blood. When lowlanders journey to high-altitude areas, they frequently suffer from a variety of hypoxia symptoms, including headaches, nausea, fluid in the lungs, loss of appetite, fatigue, insomnia, and labored breathing. For most people, these problems are alleviated as their heart, lungs, and circulatory system adjust. But even the best-adjusted lowlanders rarely are able to duplicate the activity patterns of native highlanders. Since the basic cause of hypoxia cannot be attacked without sophisticated equipment, we may conclude that the nature of highlanders' superior adjustment to low atmospheric pressure is basically biological. Their adjustment to cold and nutritional stress, on the other hand, includes reliance on cultural means—learned behavior and technology.

All humans show some rapid biological responses to stressful conditions. In the cold, almost everyone will produce more body heat through shivering or an elevation in the basal metabolic rate.



Victor Englebert

In Queros, a Peruvian village east of the ancient Inca capital of Cuzco, Quechua-speaking Indians preserve a traditional style of life adapted to high altitudes. Like their rural counterparts in Nuñoa, a district south of Cuzco that has been intensively studied by physical anthropologists, these Indians herd llamas as a major means of subsistence. The piled stone houses protect the residents from rain and wind but provide only moderate protection from low nighttime temperatures during the cold, dry season.



Loren McIntyre, CHER Agency



Increases in breathing and heart rates and red blood cell numbers are adjustments that most low-altitude residents make after arriving at high altitude. These short-term physiological responses are fairly easy to identify. The issue biological anthropologists have found more intriguing is whether the physiological and morphological characteristics of highlanders that lowlanders are unable to duplicate are the result of gradual adjustments that accumulate during the developmental years or the result of unique genetic adaptations to high altitude.

According to the best estimates, between fifteen and twenty million people live above 10,000 feet in the Andes and on the Andean *altiplano* ("high plateau"), and another three to five million live above 10,000 feet in the Himalayas and on the Tibetan plateau. While a number of good cultural and biological studies have been carried out in both these areas, the greatest amount of data is available for two groups: the 8,000 or so Quechua Indians who live on the *altiplano* in the Nuñoa district of southern Peru, and the approximately 2,500 Sherpas who inhabit the Khumbu region of eastern Nepal. The Sherpas do not actually live on the Tibetan plateau, but just south of it in the high alpine valleys of the Himalayas. Still, the Sherpas are a Tibetan-derived group that possesses many features of the larger Tibetan culture, which has not been accessible for systematic biological or cultural investigation. Information on Nuñoa comes from a large and well-integrated project initiated and, for the most part, directed by Paul T. Baker of Pennsylvania State University. Information on the Khumbu has not been collected as systematically, but taken as a whole forms a meaningful counterpart to the Nuñoan data.

As their names suggest, both the Andean *altiplano* and the Tibetan plateau are relatively flat landscapes, consisting mainly of valleys separated by rolling hills. The floors of the valleys range from 10,000 to 15,000 feet; the hills are about 1,000 feet higher. The Andean *altiplano* is rimmed by the high Andes to the east, while the Tibetan plateau is rimmed by the Himalayas to the south. These mountain ranges act as moisture barriers, preventing most of the rainfall that makes South Asia and the Amazon so lush from penetrating the high-altitude plateaus.

The Andean *altiplano* and the Tibetan plateau are cold, but not frigid, areas. Nuñoa falls within the tropical zone south of the Equator, where seasonal changes are not pronounced. Daily maximum temperatures remain consistently comfortable throughout the year: between 61° and 66°F. Nighttime temperatures, on the other hand, do show some seasonal variation and can be quite cold: average lows range from about 37° during the rainy months of April through September to 14° during the dry months of October through March. Snow is uncommon, and when it does occur, it is light and quickly melted by the warm daytime temperatures. The Khumbu region of Nepal is located in the Northern Hemisphere's temperate zone, at roughly the same latitude as Tampa, Florida. This position produces marked seasonality: in Khumbu villages between 11,000 and 12,000 feet, the average daytime maximum temperatures range from 39° during January to 64° in July; average nighttime minimum temperatures range from 14° in January to 50° in July. Winter conditions are made even more severe by periodic snowfalls. With clothing, housing, and other means, however, both the Quechuas and the Sherpas are able to modify their immediate environments to reduce cold stress significantly.

Domesticated in the New World, the potato can be cultivated successfully in high-altitude areas; it is the staple crop in both the Andes and the Khumbu. Left: Quechua women near Cuzco apply guano to green potato plants, four months after planting. Below: Sherpa women and lowland helpers plant potatoes in a Khumbu village.

Robert Weinreb



In Nuñoa and the surrounding area, considerable research has been carried out on the natural cold stress endured by the inhabitants, as well as the biological and cultural adjustments to cold stress. Most of this research has been directed by Michael A. Little of the State University of New York at Binghamton, J. Michael Hanna of the University of Hawaii, and Paul T. Baker. One finding is that on the *altiplano*, clothing offers considerable protection against heat loss.

Quechua men's underwear consists of long pants and a long-sleeved shirt. Over these are worn homemade pants and a shirt, covered by a vest and jacket. During early morning and late evening hours, when it is quite cold, men will wear heavy woolen ponchos and knitted stocking caps with earflaps. Quechua women wear several woolen mid-calf-length skirts, a blouse, a jacket, and a shawl. Mittens are rarely worn by either sex, but hands can be placed underneath clothing to be warmed. Normally, adults go barefoot or wear sandals with soles made from pieces of rubber tires. This type of clothing is remarkably effective in protecting adults against the cold. In the dry season, average skin temperatures are consistently 90°, despite an ambient temperature that fluctuates between 21° and 68°. In the wet season, hands and feet undergo greater stress but remain at temperatures of at least 74°. Perhaps the greatest exposure to cold occurs when adults must work in water, for example, washing clothes or building channels. Under these circumstances, foot and hand temperatures may fall below 59°. (Although it may cause some discomfort and reduced function, this temperature is not low enough to damage tissues in the short run. Of course, prolonged exposure can lead to a dangerous loss of internal heat.)

Children five years of age and older wear the same sort of clothing as adults and are perhaps the most subject to cold stress. But even out of doors during the wet season, toe and finger temperatures of Quechua children remain above 68°.

Infants are well protected. They are usually diapered and wear an undershirt, a homespun tunic, one or more sweaters, and a knitted hat. Nursing and changing are done near a fire, and the infant usually plays in the sunniest area near the house.

Urban houses in Nuñoa are constructed of adobe and covered with mud or plaster stucco, while rural houses are made with piled stone walls and thatched roofing. During the cold, dry season, nighttime temperatures inside adobe houses average 45°, while outdoor temperatures are well below freezing. Rural houses offer considerably less protection against the wind and cold. At night, the average difference between minimum indoor and outdoor temperatures is less than seven degrees, so that indoor temperatures fall below freezing during the cold, dry season.

During sleep, people in Nuñoa protect themselves from the cold in two ways. First, the family members usually sleep together under blankets, sharing body heat; and second, most people sleep with their clothing on. In rural areas during the cold, dry season, this type of sleeping arrangement is associated with only slight reductions in adults' body temperatures. Somewhat greater reductions occur in children's body temperatures, but these effects are not great enough to be harmful.

Despite their cultural adaptations, the Quechuas are more exposed to cold than their lowland neighbors, and therefore, they differ from nonstressed lowlanders in their biological response to cold. Like the Eskimos, Quechua adults have a slightly elevated basal metabolic rate, permitting them to maintain higher than normal internal temperatures while sustaining the peripheral blood flow necessary to warm their extremities; this is probably why the skin temperatures of their hands and feet remain high enough to prevent tissue damage even though mittens and shoes are rarely worn.

Body size and physique are also important in determining the biological response to cold. Although shorter than people in the United States, Quechuas are more stockily built. Their shorter arms and legs reduce the skin surface area relative to body weight, helping to lower heat loss and to maintain normal internal body temperatures.

In all populations, men, women, and children differ in their response to cold. Women have a larger proportion of body fat, which acts as insulation. Que-

Below: A Quechua agriculturist near Cuzco carries a bundle of cornstalks to a Sunday market. Right: A Quechua girl from the Huayhuash Mountains northeast of Lima is protected from the cold by layers of clothing. The style and abundance of her clothing and her Western shoes suggest that she is the child of an upwardly mobile Indian family.

Loren McIntyre, CHER Agency



chua women have a slightly higher internal temperature than Quechua men and therefore are probably more resistant to cold. Children, who have lower amounts of body fat and large skin surface areas relative to their body weight, are more prone to lose heat and have lower internal and skin temperatures. Consequently, Quechua children are more likely to experience cold stress than adults.

Among the Quechuas, physiological responses to cold seem to develop gradually throughout childhood. This occurs not only because of the morphological changes associated with growth but also because repeated exposure to cold may prime certain physiological responses, such as an elevated metabolic rate.

Biological adjustments to low temperatures have not yet been investigated among the Khumbu Sherpas, but the overall conclusion would probably be the same as for the Quechuas, namely, that the problem of cold stress at high altitude has been overcome to a great extent through cultural adaptation.

For the Sherpas, the need for protection is greatest during the winter months, when both daytime and nighttime temperatures are low. Traditionally Sherpas have relied upon thick clothing made from yak or sheep wool. Over their full-length undergarments, women wear full-length woolen *chubas*, or jumpers, which have flaps at the sides that can be wrapped around the back. In addition, a broad cummerbund is used to hold a brightly colored apron over the front of the skirt and, in colder weather, a heavy cloth draped around the back of the skirt. Women also wear several blouses: underblouses are made of soft cotton, while outer blouses, particularly in the winter, are made of coarse, heavy cotton. Men wear heavy woolen pants and layers of shirts, covered by vests or sweaters. A knee-length woolen coat, or *bakhu*, can be worn with both arms through the long sleeves, with only one arm through one of the sleeves, or with both sleeves wrapped around the waist. In winter, most men wear thick sheepskin coats while herding yaks or doing other work in the open. Traditionally, both sexes wore leather-soled boots, with layers of matted wool to provide insulation and cushion the feet and uppers of heavy wool that lace up the back. Men and women also wear fur-lined hats with flaps that can be pulled down over the ears.

Children, after they are about four years old, wear smaller versions of adult clothing. Infants are generally warmly swaddled in several blankets, and mothers take care to avoid exposing them to cold. They are cleaned only with warmed oils and are never changed or unswaddled away from a heat source. Toddlers frequently wear quilted coveralls with a slit in the crotch so that they can urinate or defecate without soiling their clothes. For the last fifteen to twenty years, most Sherpa children have worn Western shoes and socks, although some families still prefer the traditional boot. Neither children nor adults generally wear gloves or mittens while doing traditional chores, but most adult clothing has sufficient folds to protect hands against the cold. Toddlers' clothing does not have this advantage, and the lack of hand protection may be a source of cold stress.

Sherpa houses are built with thick stone and mortar walls that provide protection from the wind, particularly since windows are few and generally placed on only one side of the house. Most houses consist of two stories: the ground floor is used as a manger and storage area, and the family lives in one large room above. The manger may provide some heat for the upstairs, but the second-story room is so large that much of the benefit is lost. Sherpa houses have peaked roofs constructed of timber beams. These are covered by mats or by pieces of slate. The upstairs room may be thirty or even forty feet long and half as wide. A small fire, located toward one end of this room, is lit at mealtimes and, during the winter, may be kept going all the time. During the night, this part of the room will remain up to 12 degrees warmer than the minimum outdoor temperature even if the fire is allowed to go out. Away from the fire, the room temperature falls to only 4 or 5 degrees warmer than minimum outdoor temperatures. Sleeping arrangements vary: in some houses, beds are located near the fire, while in others, they are in the coldest part of the room or along the walls. Families with small children tend to sleep huddled together, covered by thick blankets. Older children may sleep

John Maddock Roberts

Use the card below to give the Gift of NATURAL HISTORY every month

Give a GIFT of NATURAL HISTORY

Give one at $15 and save 20% on subsequent gifts at $12 each

This Christmas give 12 beautiful, thought-provoking issues of Natural History to someone special. This year-long gift is appreciated by discriminating and intelligent people, and is inexpensive and easy to order. Just send this postage paid card with your order today.

☐ YES, send _____ gifts, which include 12 thought-provoking issues of Natural History and all the benefits of a one-year Associate Membership in the American Museum of Natural History. (Save 20% on all additional gifts)

J521

GIFT FROM:

Name _____

Address _____

City _____

State _____ Zip _____

☐ 1 Gift a $15 $15

☐ Additional Gifts at $12 _____
(20% savings)

Total Enclosed $ _____

☐ Payment enclosed ☐ Bill me

Charge my ☐ Visa ☐ Mastercharge
☐ American Express

Account number

Signature _____

Outside U.S.A. please add $4 postage

GIFT TO:

Name _____

Address _____

City _____

State _____ Zip _____

Gift card to read

GIFT TO:

Name _____

Address _____

City _____

State _____ Zip _____

Gift card to read

Moneyback guarantee if not satisfied

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST CLASS PERMIT NO. 30 NEW YORK, N.Y.

POSTAGE WILL BE PAID BY ADDRESSEE

Natural History
P.O. Box 4200
Bergenfield, N.J. 07621





Robert Weinreb

In the Khumbu region of Nepal a Sherpa girl herds goats past Tamang porters from the lowlands to the south, carrying rice and sugar to a weekly market. In both the Himalayas and the Andes, resources available at different altitudes are exchanged between neighboring populations.

separately and thus are more apt to be affected by the cold.

Sherpa adults probably experience the greatest cold stress in winter, when animals must be herded from high pastures to lower ones. The amount of activity involved is so great, however, that it surely must provide some metabolic compensation. In addition, prodigious amounts of Tibetan tea (tea and butter with a little salt) or tea with milk and sugar are consumed by everyone. Since drinking hot beverages elevates internal temperatures, this probably provides additional fortification against the cold.

Mountaineering, trekking, and a growing cash economy have changed Sherpa conditions somewhat during the last decade. Men tend to wear Western mountaineering dress, which is designed to maximize protection against the cold. But mountaineering expeditions now expose Sherpa men to high mountain areas that are far colder than their normal habitation zone. And because Tibetan yak wool is becoming difficult to obtain, Sherpa women now often wear *chubas* of heavy cotton, which probably offer less protection against the cold. On the other hand, the recent introduction of kerosene space heaters—and possible future availability of electric heaters—may reduce cold stress considerably.

In addition to cold, a high-altitude population must cope with marginal nutrition. In part, poor nutrition may be attributed to cultural values concerning food selection, preparation, and distribution. Nevertheless, high-altitude environments such as those of Nuñoa and Khumbu do limit the quantity and quality of food crops, just as they limit other types of vegetation. In both areas, the soils tend to be poor. Of equal importance are the hazards of low temperatures, frosts or snowfalls, and unreliable precipitation during the crop-growing season. The last is a particular problem on the *altiplano*, since planting is done during September and October when precipitation is very erratic. In the Khumbu region, dews and fogs provide moisture in the absence of heavy rainfalls.

In both Nuñoa and Khumbu, diets consist primarily of vegetable foods. Most common in Nuñoa are potatoes and Andean grains, along with rice and maize (mostly imported from other areas). Depending upon the success of the harvest, potatoes contribute up to 48 percent of the diet. Only 6 to 17 percent of the food consumed by the Quechuas derives from animal sources. Still, protein consumption in Nuñoa seems adequate, except for children under three and girls from nine to twelve. Caloric intake, on the other hand, is highly variable and may not be adequate during childhood years or during periods of physiological stress, such as pregnancy or lactation.

In Nuñoa, R. Brook Thomas of the University of Massachusetts has identified four behavioral adjustments to the low caloric potential of the environment. First, the Quechuas depend upon a mixed and spatially dispersed resource base consisting of both crops and animals that are well adapted to the environment and produce the most calories for the least amount of work. Second,

surplus resources (mostly animal products) are sold and exchanged for calorie-rich products from other areas. Third, children, who consume the least numbers of calories regardless of the undertaking, are often assigned active tasks, such as herding, that would be calorically more costly for adults. Fourth, the tasks necessary for subsistence are organized so that large amounts of time can be spent in sedentary or near-sedentary activities. Even in herding, up to three-quarters of the time may be spent in a stationary position.

The potato, which was originally domesticated in the Andes, also became the staple among the Sherpas during the late nineteenth century. It constitutes from 30 to 44 percent of the adult diet. The rest is made up of cereals, such as buckwheat and millet, mustard greens in summer, Tibetan tea, and considerable amounts of rice or millet beer called *chang*. About 80 percent of this diet is carbohydrates, and what protein there is comes mostly from vegetable sources. The result is a diet that tends to be calorically adequate but deficient in protein. Compared to the Quechuas, however, the Sherpas are more active and probably have greater caloric requirements. Herding entails continuous flanking movements on the steep mountain slopes to keep the skittish cattle from straying. In the past, long-distance trade meant journeys by foot over steep mountain passes, and at one time, teams of men were used to pull the plows that tilled the soil for buckwheat and barley. Today, mountaineering and trekking tax the strength and endurance of both men and women.

One biological consequence of inadequate caloric or protein intake is growth retardation. Among both the Quechuas and the Sherpas, physical growth is much slower than among people in the United States. Skeletal growth and mineralization are slow, the growth spurt during adolescence is retarded, and maturation is delayed until the early to mid-twenties. Far from being maladaptive, however, retarded growth and small body size can add up to a caloric saving. Thomas has estimated that for the Quechuas, the retarded growth at adolescence alone (between the ages of fifteen and twenty) saves an average of 121 calories per day, or more than 44,000 calories per year. This saving is equivalent to planting an additional 100 square yards of cropland for each adolescent every year.

Unfortunately, it is extremely difficult to tell how much of the retardation



The Loch Lomond Monster. You'll Find Proof He Exists.

Loch Ness has a nice shy monster. It bothers no one and makes no noise.

Loch Lomond has a totally different kind of monster. The men in our blending room, near Loch Lomond, see him regularly. His fearful bellows fill the air until he gets just what he wants.

His name is George Shortreed. He searches all of Scotland to find whiskies noble enough to blend with those of our very own Speyside distilleries. His knowledge and his will are what make J&B so well respected.

His stubborn, unswerving goal is to create a taste so smooth, so subtle we can say it whispers. And he'll be as harsh as he has to, to be sure J&B never is.

The men who work for him call him the Loch Lomond monster. But never when he can hear.

When George Shortreed is around, the men speak in hushed tones, and the whisky whispers.



J&B. It whispers.

86 Proof Blended Scotch Whisky. © 1981 The Paddington Corp. NY



Journey through Moroccan cities and countryside to visit the famous medieval city of Fes, the souks of Marrakech, and camel markets at Rissani, the Atlas Mountains and the Sahara Desert. Visits to Berber villages; archeological sites and museums in Tangier, Rabat, Roman Volubilis and Lixus. Tour is led by Paul J. Sanfacon, Lecturer in Anthropology at the Museum. Limited to 20 participants. For further information write to DISCOVERY TOURS, American Museum of Natural History, Central Park West at 79 St., NY NY 10024, or call (212) 873-1440.

Speak German like a Diplomat!

What sort of people need to learn a foreign language as quickly and effectively as possible? Foreign service personnel, that's who.

Now *you* can make a start on learning to speak German with the same materials used by the U.S. Department of State — the Foreign Service Institute's *Programmed Introduction to German* and *Basic Course, Continued*.

The FSI spent thousands of dollars and many years developing these materials for use by members of America's diplomatic corps. Today people in all walks of life who need to learn to speak a foreign language are turning to this outstanding audio cassette program.

The Foreign Service Institute's German Course is by far the most effective way to learn German at your convenience and at your own pace. It consists of a series of tape cassettes and accompanying textbook. You simply follow the spoken and written instructions, listening and learning. By the end of the course you'll find yourself learning and speaking entirely in German! A native German speaker, clearly recorded on the cassettes, provides an excellent model to help you develop your skills.

This course turns your cassette player into a "teaching machine." With its unique "programmed" learning method, you set your own pace testing yourself, correcting errors, reinforcing accurate responses.

The FSI's Programmed German Course comes in two volumes. You may order one or both courses

☐ **Volume I. Programmed introduction to German,** 9 cassettes, 12 hours and 647-page text, $115.

☐ **Volume II. Basic Course, Continued** 8 cassettes, 8½ hours and a 333-page text, $98

(Connecticut residents add sales tax.)

Your cassettes are shipped to you in handsome library binders.

TO ORDER, JUST CLIP THIS AD and mail with your name and address, and a check or money order. Or charge to your credit card (American Express, VISA, Master Charge, Diners Club) by enclosing card number, expiration date, and your signature.

The Foreign Service Institute's German course is uncondltionally guaranteed. Try it for three weeks. If you're not convinced it's the most convenient and most painless way to learn German, return it and we'll refund every penny you paid! Order today!

Many other F S I courses available

Audio-Forum
Dept. P–40
On The Green,
Guilford, CT. 06437
(203) 453-9794



AUDIO-FORUM®

in the rate of growth is a response to poor nutrition and how much is a response to hypoxia, the third and most severe source of stress in high-altitude areas. Most experts on the growth of Andean natives, such as A. Roberto Frisancho and Jere D. Haas, feel that both hypoxia and poor nutrition are implicated but tend to emphasize the former. The Andean data also suggest that slow growth is a developmental, not a genetic, response to high-altitude conditions. On the other hand, I.G. Pawson has concluded that slow Sherpa and Tibetan growth may be programmed genetically.

Because of hypoxia's severity, one might expect the cardiovascular and pulmonary responses of all high-altitude populations to be the same. Intriguingly, however, the Quechuas of the *altiplano* and the Sherpas of Khumbu may not possess the same kinds of adjustments. The best way to understand the characteristics of the two is to follow the pathway of oxygen from the air breathed by the lungs through the circulatory system to the active tissues.

The diffusion of oxygen from the lungs into the blood is affected by the size of the lung surface, the amount of air that is moved into and out of the lungs per minute, the amount of blood that passes through the lungs, and the speed at which it does so. Research in Nuñoa and elsewhere in the *altiplano* has revealed that the chest sizes of Quechua children and adults are larger than those of people in the United States, even though Andean natives are physically much smaller. This feature has been linked to their large lung volumes. On the other hand, the Sherpas have smaller chests than Quechuas of similar age, and adult lung volumes are far lower. The larger lungs of Andean natives indicate a greater surface area for the diffusion of oxygen into the blood.

Another factor affecting diffusion is ventilation—the amount of air that is moved into and out of the lungs per minute. For both Quechuas and Sherpas, ventilation is greater than for lowlanders tested at sea level. Among both groups of highlanders, however, sensitivity to low levels of oxygen in the blood is reduced, so that hypoxia-induced hyperventilation—so common among lowlanders tested at high altitudes—does not occur. This so-called blunted hypoxic drive may prevent a dangerous fall in the level of carbon dioxide in the blood, which normally accompanies hyperventilation.

Among lowlanders who remain a

week or more at high altitude, the number of red blood cells can increase by up to 50 percent, depending on the altitude and the length of time spent there. Since hemoglobin is the major transporter of oxygen in the blood, an increase in the number of red blood cells has generally been interpreted as a means of increasing hemoglobin and getting more oxygen to the tissues. Among *altiplano* natives, however, evidence for increases in red blood cell number has been variable. At extremely high altitudes (14,700 feet and above), red blood cell counts 50 to 60 percent above sea-level norms have been reported, while among Quechuas tested at Nuñoa, red blood cell counts are reported to be only about 10 to 12 percent above sea-level norms. By contrast, red blood cell counts of Sherpa adults and children are considerably lower, actually in the low end of the normal range for sea-level populations.

As oxygenated blood circulates through the body, the oxygen is released for use in the tissues. The unbinding, or dissociation, of oxygen from hemoglobin is enhanced among the Quechuas because at high altitudes more CO_2 is picked up by hemoglobin as red blood cells pass through the capillaries. As this happens, hemoglobin's affinity for oxygen is reduced, and more oxygen can be released to the tissues. Travelers to high altitudes and Andean natives also show an increase in their blood of a compound called 2,3 diphosphoglycerate, which has the effect of increasing the amount of oxygen released to the tissues. When oxygen concentrations are low, as in the capillaries, the 2,3 diphosphoglycerate reacts with hemoglobin, interfering with hemoglobin's affinity for oxygen. Together with an increase in the size and number of capillaries perfusing the active tissues, these characteristics insure delivery of sufficient oxygen to the tissues.

Unlike the Quechuas, Sherpas may not have increased levels of 2,3 diphosphoglycerate—at least at altitudes below 14,000 feet. Since they also do not exhibit large lung capacities or elevated red blood cell numbers, the question is, what sort of adaptation do they have? Unfortunately, the answer is not yet clear. Some data seem to show a slightly lower carbon dioxide concentration in the lungs, perhaps indicating a slightly higher ventilation. It is also possible, according to one study, that the affinity between oxygen and hemoglobin is greater for the Sherpas than for the Quechuas. But Sherpas don't appear to possess any special type of hemoglobin,

An elegant, provocative exploration of the ways "science" has attempted to rank people

"A brilliant book....The lombrosos, Hootons, Goddards, IQ testers, racists, and others of their kind, are literally taken to pieces by Gould in a book that is as important as it is readable. ...Of no book could it be more sincerely said that it deserves to be widely read."
—ASHLEY MONTAGU



The Mismeasure of Man

By STEPHEN JAY GOULD

author of *Ever Since Darwin* and *The Panda's Thumb*

Illustrated with photographs • $14.95 at all bookstores

Norton
W.W. NORTON & COMPANY, INC., 500 Fifth Avenue, New York 10110

Have More Fun With
HANDGUIDE TO THE CORAL REEF FISHES



. . . the most comprehensive, beautifully illustrated and accurate guide available for snorklers, divers and fish hobbyists. Shows 460 species in full color, along with 50 different corals, invertebrates and plants. For the beginner as well as the advanced student. Has easily-understood descriptions, useful hints on fishwatching, and unique checklists for quick identification.

4½x7½" hard cover, 160 pages.
$9.95 includes postage and handling.
Send your check today to
The Academy of Natural Sciences
Att: Publications — Handguide
19th and Parkway, Philadelphia PA 19103
PA residents add 60¢/copy sales tax.



Photo Credit: Marjorie Shostak

NATIVE INTELLIGENCE

NISA
The Life and Words of a !Kung Woman
Marjorie Shostak

Anthropologist Marjorie Shostak presents the story of a remarkably bright, independent !Kung woman, a native of the Kalahari Desert, told in her own words.

"A marvelously good book. Certainly one of the most insightful and revealing of life in a gatherer-hunter society... I know of nothing to equal this enchanting book." — Ashley Montagu

"Nisa can be outrageous, campy, melodramatic, and wildly exaggerating; she can also be funny, warm and wise... through Shostak's skill we can celebrate with Nisa our common humanity." — Richard Lee
$20.00 Illustrated

HARVARD UNIVERSITY PRESS
79 Garden Street, Cambridge, MA 02138



What was it like... the Egypt of 2000 years ago?

THE ALTAR AND THE CROWN

THE INHERITORS

A DOCTOR OF SOULS

by MARIAN NIVEN

Here is a trilogy that is a delight to read. Set in the Egypt of Ptah and the Ptolemys, it is a compelling and highly accurate picture of changing life along the changeless Nile.

"An entertaining and thought-provoking novel."
—*Louisville News and Courier*

(The author, herself an archaeologist,) is a good storyteller and a meticulous scholar."
—*Baltimore Sun*

(She) is able to build suspense; her characters have flesh and blood."—*The Living Church*

"An absorbing story."
—*St Luke's Journal*

Send now for any one, two, or three, of these entertaining and informative books.

N

THE SEABURY PRESS
Seabury Book Service, Somers, CT 06071

Please send me:

____ *Altar & Crown* @ $12.95 ____
____ *Inheritors* @ $8.95 ____
____ *Doctor of Souls* @ $10.95 ____
____ All 3 vols. (only $27) ____
Plus shipping costs ($1 for ea. bk.) ____
☐ Check enclosed TOTAL ____
(to Seabury Book Service)
☐ MasterCard ☐ Visa

ACCOUNT NUMBER

EXP DATE SIGNATURE

NAME

ADDRESS

CITY

STATE ZIP

and oxygen saturation in their blood is about the same as that of the Quechuas. Perhaps the answer lies in the way oxygen diffuses across the pulmonary membrane. Whatever the adjustments may prove to be, they must be remarkably effective. Sherpas are renowned for their ability to carry heavy loads (as much as sixty pounds, or half their body weight) at altitudes up to 23,000 feet. Furthermore, I found that their maximum oxygen consumption equaled that of the Quechuas and was similar to levels achieved by highly active lowlanders tested at sea level.

We are now fairly certain that many of the Andean adjustments to high-altitude hypoxia are not genetic. A. Roberto Frisancho has demonstrated that nonnative children who migrate from sea level to high altitudes and remain there while growing up eventually attain the same lung volumes as high-altitude natives. Sukhamy Lahiri of the University of Pennsylvania School of Medicine has also reported that neonates and infants have the same lung volumes at high and low altitudes, but that a difference appears by adolescence. The large lung volumes of Andean natives seem, therefore, to be a developmental response. In addition, Lahiri has shown that the "blunted" ventilatory response to hypoxia only begins to manifest itself during adolescence and becomes irreversible by adulthood. Again, this is strong evidence that the ventilatory rate of Andean natives is developmentally determined. Finally, Frisancho has noted that the maximum amount of oxygen that can be delivered to the tissues during exhausting work is also affected by age at migration. The younger the age at migration and the longer the stay at high altitude, the greater the maximum oxygen consumption. These findings do not rule out the possibility of genetic adaptations but, as yet, no such adaptations are apparent.

Having considered some of the ways in which Quechuas and Sherpas have adapted, culturally and biologically, to living at high altitude, it may be appropriate to conclude by evaluating the degree to which environmental stress nevertheless takes its toll among these people. The impact of altitude on survival begins even before birth. Because of the low amount of oxygen that diffuses across the placental membrane into the fetal system, all fetuses (even those at low altitude) develop in an hypoxic environment. Atmospheric hypoxia may create an additional stress for high-altitude fetuses, despite their mothers' physiological adjustments. Perhaps to maximize the amount of oxygen available to the fetus, the placentas of *altiplano* women are larger in diameter, thinner, and weigh more relative to fetal weight than is the case at low altitude. Nonetheless, both fertility and birth weight appear to be lower at high altitudes.

Although reduced, fertility in the *altiplano* is still high. Completed family size (the total number of live births to women age 45 and over) averages 6.7 in Nuñoa and is similar in other areas of the *altiplano*. In comparison, completed family size in one well-studied area of low-altitude Peru was 8.3.

Sherpa fertility is much lower—completed family size is about 5.1. Part of the difference may be explained by various cultural factors that seem to lower Sherpa fertility. In the past, low iodine intake caused a significant proportion of the Khumbu population to suffer from hypothyroidism, which is known to result in an extremely high level of spontaneous abortions.

Low birth weight also seems to be a consequence of gestation at high altitude. Jere D. Haas reports that children born of Quechua mothers at high altitude weigh about three-and-one-half ounces less than children born to Quechua women at low altitude. And children born to non-Indian women at high altitude weigh more than a pound less than those born at low altitude. Fewer data are available for the Sherpas, but nineteen neonates weighed by physicians at the Kunde hospital between 1967 and 1972 were, on the average, nearly one-half pound lighter than high-altitude Quechua neonates. The reduction in birth weight is important because it is associated with inadequate respiratory function, poor temperature regulation, poor resistance to infection, a high incidence of anemia, and inadequate renal function. Despite the apparent differences in birth weights, the *altiplano* and the Khumbu region have equally high infant mortality rates: between 150 and 160 per 1,000 live births (about twelve times the U.S. rate).

To a certain extent, these rates are the result of diseases (such as gastrointestinal disorders) that cause high infant mortality regardless of altitude. But others, particularly respiratory diseases, are more common causes of death at high altitude. Some studies show that the effect of altitude on infant mortality may be especially strong immediately following birth. In both Peru and the United States, deaths during the first

AMERICA'S TRUCK, BUILT FORD TOUGH.



LION IN WINTER.

Bronco roars to the top nonstop. Its husky 4.9L (300) Six churns out more torque than any competitive Six. It also turns out excellent gas mileage ratings: 24 est. highway, ⑰ EPA est. mpg.*

Inside it's a real family 4-wheeler. There's room for six with front and rear bench seat options (front buckets are standard). But Bronco's trim outer size makes it easy to maneuver, fun to drive *wherever* you drive.

Underneath you'll find the only independent front suspension in an American-built sport utility. It's smooth *and* tough!

Mileage-boosting 4-speed overdrive, another Ford first, is optional. So are automatic locking hubs. They run free on the highway, lock in automatically when you shift to 4WD.

No other 4-wheeler offers all this. So why settle for less than Bronco—it's one beautiful beast!

* 4.9L Six and optional overdrive. Use for comparison. Your mileage may differ depending on speed, distance and weather. Actual highway mileage lower. California ratings less, V-8 required.

FORD BRONCO

FORD DIVISION Ford

Haband's

Flannel Lined Winter Slacks

only 21.95



NOT A NECESSITY, BUT WORTHWHILE LUXURY!

The outer fabric is tight woven wind-breaking polyester and cotton poplin. A great all-weather quality cloth. And on the inside, they're **completely lined, from waist to cuffs, with the softest, warmest, most comfortable polyester/cotton plaid flannel fabric that ever kept you warm and dry!**

Permanent Press to hold their knife-like crease. Machine wash and dry, of course! *(We wouldn't ask you to worry about something like that!)*

In Navy or Tan, but you'll want both! Designed for bitter outdoor weather, there's no law that says you can't wear them indoors too, especially during a fuel crisis!

Order now! At Haband's inflation-fighting low price, combined with the wintry forecast and fuel uncertainty, we know these slacks won't be in stock for very long!

FLANNEL LINED WINTER SLACKS 21.95 2 for $43

HABAND COMPANY, Executive Division
265 N. 9th St., Paterson, N.J. 07530

Please send ... pairs. I enclose $..... plus $1.35 toward shipping.

Even Waist Sizes 30 thru 54* Inseams 26 to 34

*Waists 46-54 please add $2 per pair.

Guarantee: *If on receipt I don't want to wear them, I may return the slacks within 30 days for full refund of my remittance.*

COLOR	Waist	Inseam
NAVY A		
TAN B		

Or Charge to:
VISA
MasterCharge
797-039

Acct # _____
Exp.Date __/__/__

Name _____
Street _____ Apt. # _____
City _____
State _____ Zip _____

HABAND COMPANY

Frank Ward



In a teashop in the Takshindu Pass, on the route to Mount Everest, a Sherpa nun makes rakshi, *a liquor distilled from grain or potatoes. The teashop, on the grounds of a Buddhist monastery, earns money by providing overnight lodging for porters and Western travelers.*

month after birth are more frequent at higher elevations. This may partly explain why, in the late 1960s and early 1970s, infant mortality in the Khumbu and in Nuñoa was between 15 and 20 percent higher than for Nepal and Peru as wholes.

Throughout childhood and adulthood, both Sherpas and Quechuas are plagued by respiratory diseases. They are the major cause of death at all ages in the *altiplano* and the most frequent diagnosis made by physicians at the Kunde hospital in Khumbu. Second in importance are gastrointestinal disorders. In both areas, uncontrolled diarrheas are a common cause of infant and early childhood mortality. One bright feature in the health picture is the absence of cardiovascular diseases. Blood pressures in both groups are low by U.S. standards, and do not appear to increase significantly with age.

In both groups, hypoxia, poor nutrition, disease, and physical trauma combine to significantly reduce survivorship. Only about 65 percent of the Sherpas survive to adolescence, and the rate is roughly the same for the Quechuas in Nuñoa. For those Quechuas who survive past age fifteen, the average age at death is about forty-nine-and-one-half years for pastoralists and about fifty-five years for nonpastoralists. The Sherpas' average life expectancy at age fifteen appears to be between forty-eight and fifty years.

A short life is not unique to these two high-altitude populations. Among many lowlanders, particularly in developing countries, life expectancy is equally short. But the reasons for death may be quite different. At high altitude, respiratory and some infectious diseases seem to be more common, and it is possible that high-altitude Peruvians suffer from an increased level of congenital heart defects. On the other hand, some particularly devastating low-altitude diseases rarely penetrate to high-altitude areas. This is the case for malaria—one of the major causes of death worldwide—because environmental conditions prevent the spread of the disease-bearing mosquito to high altitudes.

There is no doubt that both the Sherpas and the Quechuas have made physiological and morphological adjustments to high altitude that help them to exploit their limited environment. Even in conjunction with important cultural adaptations, however, the biological adjustments cannot completely protect these people from the stress of their environment. The consequence—contrary to some popular assumptions concerning unusual longevity and good health among high-altitude populations—is lowered fertility, a prevalence of respiratory disease, and death at a fairly early age. □

AMERICAN MUSEUM OF NATURAL HISTORY
Vacations on sea and land with Museum Lecturers



NILE CRUISE: Explore the astounding ancient sites and natural wonders of Egypt with a Museum geologist, ornithologist illustrator, and Egyptologist. Cruise 600 miles on the Nile from Cairo to Assuan aboard the custom-built, air-conditioned *Nile Star* stopping at all the important sites which have intrigued visitors since their construction.

INDONESIAN ODYSSEY: Cruise through the paradise islands of Bali, Java, Komodo, Sulawesi, Lombok, Flores, Butung, the Moluccas and Luciparas aboard the luxury vessel, *Regina Maris*. Share with a Museum astronomer, anthropologist, ornithologist, geologist volcanologist, and herpetologist a unique, in-depth travel experience. The itinerary takes you to lush tropical landscapes with exotic peoples influenced for centuries by India, Islam and Europe.

GALAPAGOS ISLANDS CRUISE: Discover a special natural world with fantastically tame and exotic animals such as sea lions, giant tortoises, marine and land iguanas and countless rare and beautiful birds. Enjoy the expertise of a Museum ornithologist and herpetologist and four local naturalists as we cruise through this equatorial archipelago which so influenced Darwin.

ADRIATIC AND AEGEAN ADVENTURE: Relive the great historical travels of the Greeks, Romans, Phoenicians and Venetians. Follow their paths on a classical cruise starting in Venice and going to Dubrovnik, Corfu, Corinth, Crete, Rhodes, Tunis, Carthage, Malta, Sicily, Pompeii, Herculaneum and Naples. The *Orpheus* will be your home for 14 beautiful days; the Museum faculty will be outstanding.

LAND PROGRAMS: Seven outstanding overland itineraries have been custom-designed for small groups of 15-25 participants. Famous and remote sites and cultures are discovered while staying at the finest accommodations available with expert Museum Lecturers.

DESTINATION	1982 Dates
Archeology Tour to Mexico	January 11 to 29
Ancient Maya Archeology	February 1 to 18
East African Safaris	February 3 to 21
	February 24 to March 14
Nile Cruise	February 7 to 27
Indonesian Odyssey	February 21 to March 13
Art and Archeology Tours to China	March 23 to April 15
	April 7 to May 3
	September 16 to October 13
Anthropology Tour to Morocco	April 4 to 17
Galapagos Islands Cruise	June 5 to 17
Alaskan Wildlife Adventure	June 25 to July 12
Adriatic and Aegean Adventure	August 31 to September 1

For further information concerning the Discovery Tours program mail the attached card to the Museum's travel office or call (212) 873-1440.

American Museum of Natural History

Discovery Tours

Central Park West at 79th Street New York N Y 10024
(212) 873-1440



THE MUSEUM SHOP

For your holiday gift giving, remember the Museum Shop. You can visit us or mail this coupon for a new fall catalog.

American Museum of Natural History Museum Shop Catalog, Department NH
CPW at 79th St.
New York, N.Y. 10024

Name

Address

City

State Zip

DISCOVERY TOUR TO THE NILE



American Museum of Natural History
Discovery Tours

Discover the world of ancient and modern Egypt on an American Museum 600 mile Nile Cruise. Explore with three lecturers the rich natural and archeological sites of an area which has fascinated visitors for centuries... A carefully planned itinerary (with a special two-day program in London visiting the British Museum with its keeper) provides a relaxing and thorough three-week Discovery Tour. All of the major Nile archeological sites as well as the important wildlife regions are discussed and visited with your balanced team of eminent lecturers. Share with Museum staff and friends an unforgettable cruise. February 7-27, 1982. For further information and itineraries write to the **American Museum of Natural History, Discovery Tours,** Central Park West at 79 St., NY NY 10024, or call (212) 873-1440.

Snowshoe Hares (p. 46)

W.B. Grange's *The Way to Game Abundance* (New York: Charles Scribner's Sons, 1949) is a thorough treatment of the subject of game management, emphasizing the need to match control strategies with an animal's life patterns and environmental interactions. Part of the section on population cycles is devoted to the snowshoe hare, outlining the mechanism and simultaneity of its cycle, the changes in its habits and psychology, and the nature of predation. L.B. Keith's *Wildlife's Ten Year Cycle* (Madison: University of Wisconsin Press, 1963) presents information on the ten-year cycle, a phenomenon of long-term fluctuations in northern wildlife populations, and systematically reviews what is known about these fluctuations—their periodicity, regularity, amplitude, and synchrony; relationship to other population phenomena; and postulated causes. Extensive data on the snowshoe hare, dating from 1849, are analyzed and interpreted. G.E. Hutchinson's *An Introduction to Population Ecology* (New Haven: Yale University Press, 1978) is a comprehensive, readable introduction to the interrelationships in nature that determine ecological balance and explain behavior. Although the author uses mathematics to explain his subject, it is kept to a minimum and is, for the most part, simple. *Stability and Complexity in Model Ecosystems*, edited by R. May (Princeton: Princeton University Press, 1974), illustrates various hypothesized relationships in nature through the use of ecosystem models. The book is clearly written but it demands a knowledge of statistics, matrix algebra, and differential calculus. J. P. Finerty's *The Population Ecology of Cycles in Small Mammals* (New Haven: Yale University Press, 1980) takes a look at all the different hypotheses of animal cycles, particularly the well-documented snowshoe hare cycle. The first section is a natural history of lemming, vole, and hare cycles; the book later involves fairly high-level mathematics. D.H. Janzen's "New Horizons in the Biology of

Additional Reading

Plant Defense" (in *Herbivores: Their Interactions with Secondary Plant Metabolites*, edited by G.A. Rosenthal and D.H. Janzen, New York: Academic Press, 1979, pp. 331–50) is a general outline of plant–herbivore interactions, presenting data on plant-induced mechanisms. Also readable, although written in a technical format, is E. Haukioja's "On the Role of Plant Defenses in Herbivore Population Fluctuations" (*Oikos*, vol. 35, pp. 202–12).

Great Plains (p. 54)

Historian W.P. Webb's classic history *The Great Plains* (Lincoln: University of Nebraska Press, 1981, $9.95), originally published in 1931, has recently been reissued in paperback. Webb's account of the interactions between the central plains and the people who settled it includes physical description, history, anthropology, literature, and economics. *Love Song to the Plains* (Lincoln: University of Nebraska Press, 1966, $3.50 in paperback) is M. Sandoz's lyrical salute to the area and the different types of people who became plainsmen. G. Hyde spent thirty years studying the Pawnee, the Plains tribe whose territory once spanned from Nebraska to Mexico. His 372-page assessment of the tribe, its culture, religion, and political organization is *The Pawnee Indians* (Norman: University of Oklahoma Press, 1974). P. Farb's *Face of North America*, with illustrations by J. Connolly (New York: Harper and Row, 1963), is a well-written, standard natural history of the continent, with a section devoted to the Plains.

Terns (p. 62)

Two popular books on terns are M. Harwood's *The View from Great Gull* (New York: E.P. Dutton, 1976), about terns on Long Island, New York, and J. Hay's *The Spirit of Survival* (New York: E.P. Dutton, 1974), a natural and personal history of the common tern. Both are easy to read and accurate. A classic study on which most recent work is based is R.S. Palmer's *A Behavior Study of the Common Tern* (*Proceed-*

The Aviator Shirt.

Authentic. Manufactured by Van Heusen—the people who supply most of America's leading airlines. Features button-through flap pockets, one with pencil slot. And epaulets, naturally. Collar looks neat and correct worn open or with tie. Extra-long tail. This special edition Van Heusen shirt is cut for comfortable fit, and smartly tailored of military-weight poplin. The 65% Dacron® polyester/35% combed cotton fabric delivers the comfort you want plus the permanent press convenience you demand. Choose khaki, blue or white. Short sleeves $16. Long sleeves $17.

® DuPont registered trademark



Size Chart for the Aviator Shirt

Neck Size	14½	15, 15½, 16, 16½, 17	17½
Sleeve Length	Med (32/33)	Med (32/33) or Long (34/35)	Long (34/35)

When ordering, indicate sleeve length by using letters M or L

Neck sizes for short sleeve shirts 14½ to 17½

LONG SLEEVE @ $17

Qty	Color	Neck Size	Sleeve Length M or L
	White (19-567Y)		
	Blue (19-568Y)		
	Khaki (19-569Y)		

SHORT SLEEVE @ $16

Qty	Color	Neck Size
	White (19-560Y)	
	Blue (19-561Y)	
	Khaki (19-562Y)	

Add $2 per order for shipping and handling, plus local taxes where applicable
Make checks payable to Baker Street Shirtmakers
Mail your order...or call toll free (800) 528-6050
Personal Check or Money Order ☐ Visa American Express Master Charge
Card # _____ Exp. Month _____ Year _____
☐ Mr. ☐ Mrs. ☐ Ms. _____
Address _____
City _____ State _____ Zip _____

Baker Street® Shirtmakers
Creators of classic shirts at affordable prices
281 Centennial Avenue, Piscataway, New Jersey 08854 BAW

100% U.S. GOVERNMENT SECURITIES IN A NEW MONEY MARKET PORTFOLIO.

HIGH MONEY MARKET YIELDS PLUS SAFETY PLUS FREE CHECK WRITING!



Now Vanguard offers you a choice of all-American money market portfolios.

Their new Federal Portfolio consists 100% of securities guaranteed or backed by the U.S. Government and its agencies. So, although the Portfolio's shares themselves are not guaranteed or backed by the U.S. Government, all its investments are.

And Vanguard's popular Prime Portfolio invests primarily in high-quality money market securities of major U.S. banks and corporations.

Which Portfolio is right for you? Send for your free Information Kit, and then decide. You'll find full details of Vanguard Money Market Trust, including free check writing, no sales charge and low operating costs.

FREE MONEY MARKET KIT INCLUDES:

Informative Prospectus with full details and an Account Registration Form... "When you want more from your cash," an explanation of how the Trust works... and How to Write a Check and earn daily dividends until it clears.

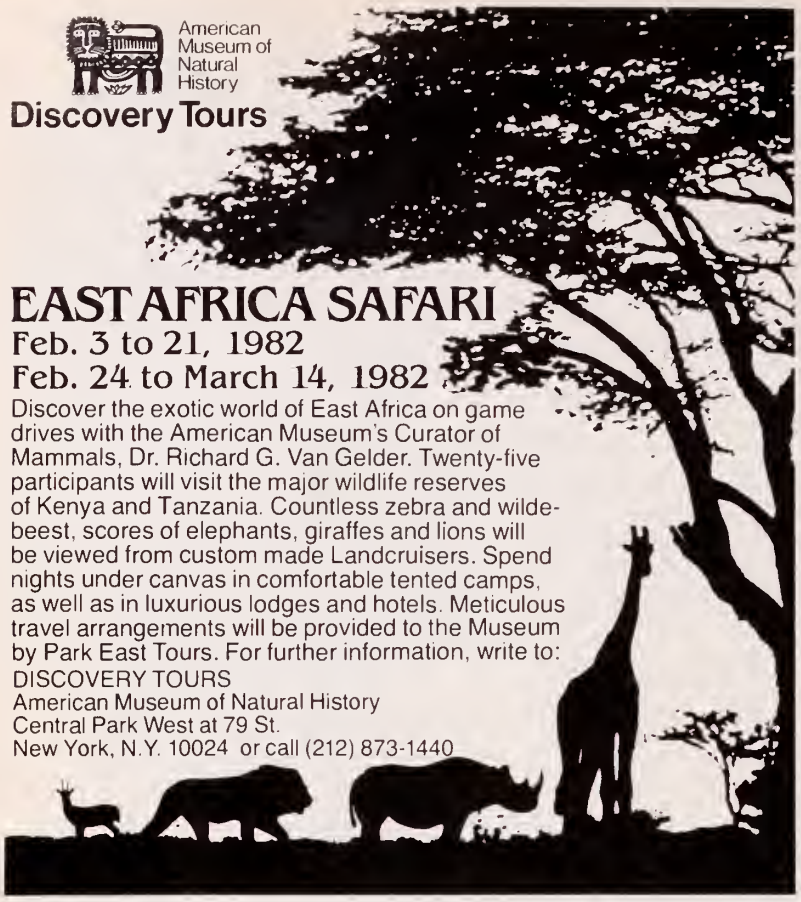
FREE MONEY MARKET KIT: CALL TOLL-FREE 800-523-7025* OR MAIL THIS TODAY

Vanguard MMT, Drummer's Lane, Valley Forge, PA 19482
YES, please send me your exclusive Information Kit—including a prospectus, so I may read it carefully before I invest or send money. I understand that it includes more complete information about advisory fees, distribution charges and other expenses. 35-NH-B1-305

NAME _____
ADDRESS _____
CITY _____
STATE _____ ZIP _____
***IN PENNSYLVANIA CALL 800-362-0530**

A MEMBER OF THE
Vanguard
GROUP OF INVESTMENT COMPANIES
OVER 50 YEARS OF SERVICE TO INVESTORS • OVER $3.5 BILLION IN ASSETS

American Museum of Natural History
Discovery Tours



EAST AFRICA SAFARI
Feb. 3 to 21, 1982
Feb. 24 to March 14, 1982
Discover the exotic world of East Africa on game drives with the American Museum's Curator of Mammals, Dr. Richard G. Van Gelder. Twenty-five participants will visit the major wildlife reserves of Kenya and Tanzania. Countless zebra and wildebeest, scores of elephants, giraffes and lions will be viewed from custom made Landcruisers. Spend nights under canvas in comfortable tented camps, as well as in luxurious lodges and hotels. Meticulous travel arrangements will be provided to the Museum by Park East Tours. For further information, write to:
DISCOVERY TOURS
American Museum of Natural History
Central Park West at 79 St.
New York, N.Y. 10024 or call (212) 873-1440

Mister, You Got Yourself a Horse
Tales of Old-Time Horse Trading



Edited, with an introduction, by Roger L. Welsch

Plains folklorist Roger Welsch edits a lively collection of stories by a group of master storytellers—those old-time travelling horse traders. He presents these first-hand accounts just as they were told to Federal Writers Project fieldworkers in the 1930s, and he supplies background information on the narrators and their craft.

Whether you read them as folklore, history, or literary narrative, these stories radiate the gusto of a growing country and the humor, personality, and adventures of that legendary American figure—the horse trader. xii, 207 pages.
$14.95

also available

Buckaroos in Paradise
Cowboy Life in Northern Nevada
By Howard W. Marshall and Richard E. Ahlborn

This catalog of an exhibition held at the Smithsonian Institution documents a way of life that has changed little since the 1860s. *Buckaroos in Paradise* shows the life of the buckaroo from three major perspectives: his geographical and historical setting, his tools, and his bunkhouse. xvi, 96 pages, 151 photographs.
Paper BB 784 **$15.95**

University of Nebraska Press
901 North 17th Lincoln 68588

George D. Lepp



ings of the Boston Society of Natural History, vol. 42, pp. 1–119, July 1941). Palmer's report, based on his fieldwork in Maine, contains little on taxonomy, ranges, and migration, but it does include a compact life history. It also focuses on aspects of the environment that affect the tern's breeding season and the bird's behavior during the breeding cycle. *Life Histories of North American Gulls and Terns*, by A.C. Bent (New York: Dodd, Mead and Co., 1947), includes the habits of each bird, its food, plumage, voice, range, courtship, eggs, young, nest, and migration. Bent includes a section on the least tern, focusing on its habits and distribution (pp. 170–79). I. Nesbit, who studied terns in Cape Cod for four years, observing their nesting behavior and trying to discover the reason for their population decrease, wrote extensive captions for *National Geographic*'s photo essay "Friend of the Wind: The Common Tern," with photographs by H. Alexander (August 1973, pp. 234–47). "Late-Blooming Terns," by P.A. Buckley and F.G. Buckley (*Natural History*, April 1976, pp. 46–55), discusses the mating, nesting, and nurturing behavior of the royal tern, including descriptions of the variety of coloration in the royal tern's eggs and chicks, the phenomenon of crèche-forming, and the extended developmental period of the young. M. Harwood's "Dawn to Dark, Day In and Day Out, Tern Study Is a Labor of Love" (*Smithsonian*, August 1980, pp. 28–37) is an account of life on an island "laboratory" devoted to tern study told in a humorous and informative manner.

Weathering Heights (p. 72)

C. von Fürer-Haimendorf's *The Sherpas of Nepal* (Berkeley: University of California Press, 1964) covers the



social and religious life of these people; his book on life in highland Nepal, *Himalayan Traders* (New York: St. Martin's Press, 1975), is in some sense a sequel in that it describes the transformations in Sherpa life that have occurred since his previous book. *Himalayan Traders* analyzes the trans-Himalayan trade, which once represented an essential element in the Sherpa economy; the economic and political upheavals that have changed the lives of these mountain dwellers; and Sherpa reaction to the decline of trade. *Man in the Andes*, edited by P. T. Baker and M.A. Little (Stroudsburg: Dowden, Hutchinson, and Ross, Inc., 1976), is a multidisciplinary study of the Quechuas, comprising seventeen articles by scientists investigating the biology of human populations at high altitude in the district of Nuñoa and other parts of southern Peru. It includes chapters on "Growth and Morphology at High Altitude," by A.R. Frisancho (pp. 180–207), "Natural Exposure to Cold," by J.M. Hanna (pp. 315–31), and "Physiological Responses to Cold," by M.A. Little (pp. 332–62). See also A.R. Frisancho's text, *Human Adaptation* (Saint Louis: C.V. Mosby Co., 1979). H.C. Buechler and J.-M. Buechler's case study on *The Bolivian Aymara* (New York: Holt, Reinhart and Winston, Inc., 1971) focuses on the inhabitants of Compi, a community on the shores of Lake Titicaca on the Bolivian high plateau. The Buechlers view the community as part of a complex system rather than in isolation; from this standpoint, they report on Compi's economic and social organization, childhood in the community, the family, the fiesta system, and religion. The book also provides references and recommended readings.

Rita Campon

SALE! ~~$24.95~~ ~~$22.95~~ NOW $19.88 with coupon below!

TIRED OF BUYING JUNK?

GET A Dorsay Floor & Carpet Sweeper

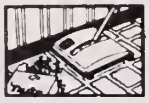


The DORSAY Floor and Carpet Sweeper is built with care by people who make nothing else, for people who believe household appliances should last a lifetime. We also think appliances should be noiseless, convenient, pretty, efficient and require no electricity.

If you feel the same way, you're going to love a non-electric DORSAY Floor and Carpet Sweeper. We believe it is the lightest, strongest, most efficient and convenient appliance of its type on earth. In the past 6 years, thousands of commercial users worldwide (airlines, hotels, restaurants, etc.) have confirmed our belief by demanding only our floor sweepers. A DORSAY Floor and Carpet Sweeper weighs under 3 pounds, is only 9 inches wide and works as well on a bare floor as it does on carpet. It picks up sugar, sand, pet hairs, paper clips, ashes and much more. Who really needs a vacuum cleaner?

Yes, it looks like an old-fashioned "carpet sweeper" (except it is far smaller and about ⅓ the weight), but there the similarity ends. The DORSAY Floor and Carpet Sweeper is patented and based on entirely new technology. Its natural hog bristle brush will outlast synthetics by about 3 to 1. It should last a lifetime if properly cared for in ordinary household use. The DORSAY Floor and Carpet Sweeper baked enamel surface wipes clean with a damp cloth. Horse hair corner brushes clean right up to the wall, and the whole sweeper can be hung up in 2 inches of wall space. EVERY PART IS REPLACEABLE AND CARRIED IN STOCK.

If you can find any other sweeper that can make the above claim, BUY IT. We are sure you can't, so we want you to try our DORSAY Floor and Carpet Sweeper.



Pick up unexpected messes in seconds.



Clean stairs quickly & easily.



Reach hard-to-get-at-places.

The Dorsay Floor & Carpet Sweeper



NO NOISE, NO HOSE, NO ELECTRIC CORDS

Only $19.88 plus $3.50 for ship./hand

MASTER CHARGE & VISA CUSTOMERS MAY CALL IN ORDERS DIAL 914-562-5177

30-Day Money-Back Guarantee

If you decide the DORSAY SWEEPER is unsatisfactory FOR ANY REASON simply return it to us within 30 days and we will refund the entire purchase price. You can't lose.

ROYAL HOUSE, Dept. ROS1316 • 137 Walsh Ave. Box 4305 • New Windsor, New York 12550

Please send me ___ Dorsay Sweepers at $19.88 each plus $3.50 heavyweight shipping, handling and insurance.

SAVE! Order 2 Dorsay Sweepers for $39.50 plus $5.50 heavyweight shipping, handling and insurance.

SAVE MORE! Dorsay Sweepers make great gifts. Order 4 for $78.60 plus $6.75 heavyweight shipping, handling and insurance.

Enclosed is $_____ (NY residents add sales tax)
CHARGE IT Master Charge Visa Exp. Date ____
Card # _____
Signature _____
Name _____
Address _____
City _____ State ____ Zip ____

1981 Royal House



ARCHEOLOGY TOUR TO MEXICO January 11-29, 1982

ANCIENT MAYA ARCHEOLOGY February 1-18, 1982

Discover the ancient civilizations and archeology of pre-Columbian Mexico and the Maya world with the American Museum's C. Bruce Hunter. Sites on the Mexican tour include Mexico City, Cuicuilco, El Tajin, Jalápa, Cholula, Teotihuacan, Tula, Oaxaca, Mitla, Monte Alban, Cuernavaca, Xochicalco and Taxco. The Maya tour includes visits to Merida, Dzibilchaltun, Chichen Itza, Tulum, La Venta, Palenque, Edzna, Uxmal, Sayil, Xlapak and Labna. Tours include colonial towns, museums and the finest accommodations, and are limited to 18 participants. C. Bruce Hunter is Lecturer in Archeology at the American Museum, and author of A Guide to Ancient Mexican Ruins and a Guide to Ancient Maya Ruins. For further information write to DISCOVERY TOURS, American Museum of Natural History, Central Park West at 79 St., NY NY 10024, or call (212) 873-1440.

THE AMERICAN MUSEUM OF NATURAL HISTORY

Adriatic, Aegean & North Africa Cruise

August 31 to September 1 1982



Discover the ancient and natural wonders of Italy, Greece, Crete, Sicily, Tunis and Malta with seven distinguished lecturers and friends of the American Museum.

Dr. Thomas D. Nicholson, Director of the Museum, invites you to join him on this unique educational vacation retracing the great historical travels of the Greeks, Romans, Phoenicians and Venetians.

Our custom-designed itinerary will be executed by Swan Hellenic whose meticulous arrangements assure you of a relaxed, care-free vacation.

Discuss the fascinating ancient sites with renowned experts in Classical times... see and identify a host of European birds in migration with our staff ornithologist... explore beautiful islands, sea coasts and volcanoes with our Museum geologist... share evenings on deck with Dr. Nicholson learning of the ancient navigators and the stars that guided them.

For further information send us the postage-paid insert card in this issue of Natural History, page 87, or call the Discovery Tours Office, (212) 873-1440. Discovery Tours is the American Museum's travel program whose office is in the Museum complex, Central Park West at 79th Street, New York, NY 10024.

American Museum of Natural History

Discovery Tours

THE MARKET

Antiques

EARLY SCIENTIFIC INSTRUMENTS Send $2 for illustrated list of antique microscopes, telescopes, sundials, scales, surveying and navigation instruments for sale Tesseract, Box 151, Hastings-on-Hudson NY 10706

Art

A COAT OF ARMS, brilliant Jewel of Heritage' is the perfect Christmas gift! Write now for full information: Athol Heraldry Box 9N Athol, MA 01331

AUDUBON PRINTS, original handcolored birds and animals Write Audubon, 9720 Spring Ridge Lane Vienna, VA 22180

BEAUTIFUL CIBACHROME PRINTS: numbered and signed by the artist, illustrated literature G Anthony, 2030 Duck Lake Rd Whitehall, MI 49461

PRE-COLUMBIAN COLLECTIBLES

GODDESS OF THE NEW MOON AT ACTANI —one of many splendid Mayan rubbings/serigraphs! Full-color catalog $2.00 (refundable first purchase).



BERNARDO
2400 Westheimer Road
Suite 108 West (NH11)
Houston, Texas 77098

DEVIL MASK, Taiwan, 10", wood, $29.00, request photo, other masks available. McCoy Imports, Liberty, NY 12754

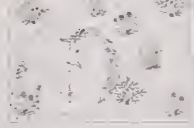
FREE! COLOR BROCHURE, Large National Park Prints by M. Woodbridge Williams. Photo Classics, Dickerson, Maryland 20753

JAVANESE SHADOW PUPPET POSTERS from the Javanese shadow play. Full size (20"x26") strikingly beautiful black on white reproductions. They are excellent both for framing and as interesting gifts. $10 Shadow Graphics, Putney VT 05346

NATURAL HISTORY prints, notecards write for free sample to Poverty Graphics, 26 Edgewood, Bar Harbor, Maine 04609

● **THE LEGENDARY UNICORN** ●

comes to life in this unique 17"x22" art poster/ capturing the ancient creature in a new, whimsical & amusing pose. This full color poster comes ready for framing. A great hang up!



Enclosed is my check for _____ for ___ poster(s). Send $5.50 (2 for $10.00) to:

IL residents add 6% ● outside U.S.A. add $1.00

Our Solution ● P.O. Box 403
Lake Bluff, IL 60044

Name _____

Address _____

City _____ State _____ Zip _____

Allow 4-6 weeks for delivery

POPULAR CERAMICS! The leading ceramic hobby magazine Gorgeous color photos how-to instruction by top artists! 12 issues $12 Sample copy $1.15 plus 60¢ postage Popular Ceramics, Dept N, P.O. Box 6466 Glendale CA 91205

SHOP AT HOME FOR FINE ART Northwest Coast Indian masks totems, graphics Eskimo sculpture Southwest Indian pottery baskets rugs and kachinas No catalogue One-of-a-kind pieces, individually photographed Priced $100 up Write for photos and data specifying interests Box 5896, Sherman Oaks, CA 91413 (213) 789-2559

Book Publishers

PUBLISH YOUR BOOK! Join our successful authors Publicity advertising, beautiful books. All subjects invited Send for fact-filled booklet and free manuscript report Carlton Press, Dept NHK 84 Fifth Avenue New York 10011

Books

ADLER's (CY) ECOLOGICAL FANTASIES—Death From Falling Watermelons Praised by Eugene Odum, AAUW Charles Luce Abel Wolman Library Journal Adopted universities Lucid entertaining, insightful solutions to environmental problems 350 pp $15.95, Greeneagle Press, 241 West 97th St NY, NY 10025

BOOKFINDING Librarians search worldwide titles or subjects plus 150,000 indexed stock PAB, 2918 Atlantic Atlantic City NJ 08401 (609) 344-1943

BOOKS ON NATURAL HISTORY Rare & OP Catalogue $2.00 Melvin Marcher 6204 N Vermont, Oklahoma City, OK 73112

PUBLISHERS' OVERSTOCKS BARGAIN BOOKS 2,000 titles, all subjects! Free catalogue Hamilton's, 98-55 Clapboard, Danbury, CT 06810

Collector's Items

RECEIVE VALUABLE MINERALS MONTHLY! Free Details! Write today! Mineral of the Month Club, 13057-H27 California Yucaipa CA 92399

Correspondence

MAKE FRIENDS WORLDWIDE through international correspondence Illustrated brochure free! Hermes-Verlag Box 110660 NH D-1000 Berlin 11 West Germany

ORIENTAL WOMEN SEEK CORRESPONDENCE for cultural exchange, language practice, friendship. Asian Exchange, Honokaa Hawaii 96727

PENFRIENDS-ENGLAND-USA Make lasting friendships through correspondence Send age, interests. Free reply Harmony, Box 89NH Brooklyn, NY 11235

Education

EROS-LANDSAT IMAGERY—2 x 2 slides with explanation—Topics include five sets—Crustal Dynamics $40, Rivers $40, Coastlines $36, Environment & Conservation $36, and Glaciers $24 See how the earth looks from a satellite 570 miles up Science by Saia P.O. Box 346N, Deer Park NY 11729

EXPLORE MICROSCOPIC WORLD—algae, zooplankton, protozoans tissues, etc New Science Courses for all ages A guide to selecting and operating a microscope with free brochure Life Sciences, Box 591-BB, Woodbury, NJ 08096

Employment Opportunities

AUSTRALIA NEEDS YOU! Jobs! Paid Transportation! Newest handbook $2.00 (guaranteed) Australian International Services, Box 19107-RY, Washington DC 20036

AUSTRALIA—NEW ZEALAND! 50,000 Jobs! Big pay Free transportation Employer listings $2.00 Austco Box 772-NH Cypress CA 90630

OVERSEAS—ALL OCCUPATIONS! Worldwide Directory and complete information—$3.00 International Opportunities Box 19107-RY Washington DC 20036

OVERSEAS JOBS—68 COUNTRIES! Hiring now! Paid fare Computerized reports $2.00 Jobworld Box 681-NH, Cypress CA 90630

ROCKY MOUNTAIN EMPLOYMENT NEWSLETTER! Colorado, Idaho Montana Wyoming! Current openings—all occupations! Free details Intermountain 4Y 3506 Birch Cheyenne WY 82001

Financial

FINANCIAL AID FOR COLLEGE For information mail SASE to Ralph Hill Dept L 709 Donaldson St Highland Park NJ 08094

GET CASH GRANTS—from Government (Never repay.) Also, cash loans available All ages eligible Complete information $2 (refundable) Surplus Funds-NH, 1629 K St Washington, D.C. 20006

Foreign Newspapers

WORLDWIDE ENGLISH NEWSPAPERS 65 countries including Zimbabwe Sampler 5 $2.98 Free Brochure Multinewspapers, Box DE-211 Dana Point, CA 92629

Gourmet Interests

BEST GRITS you ever ate Authentic New Orleans family recipe $2 The Purple Kitchen Box 147NH, New Suffolk NY 11956



Cooking On Your Wood Stove ©

Cook book of 100 delectable recipes Toast your tootsies while you stew the dinner

3 Turkey Hill Lane — $6.95
Westport, CT 06880 — Postpaid

FIVE SUPERB HOMEMADE RECIPES with international flair $5.00 Dept 9, 2713 Via Montecito San Clemente CA 92672

FLAVOR WINTER SOUPS, stews chowders with native Carolina Bay leaves Ten gram packet $2.00 with SASE Herbs, Box 685, Carrboro, NC 27510

HOLIDAY POULTRY STUFFING, $2 Chriscookery Box 571 Huntington Station, New York 11746

TABLE SETTING PARTY TIPS, plus easy recipes $5.00 for pamphlet N Ross Suite 337 Box 33 Long Beach, CA 90801

TRADITIONAL HOLIDAY BREAKFAST! Family recipe from Portugal $1.00 SASE, KH, 500 Greenacres Dr Huntsville, AL 35805

VERMONT MAPLE SYRUP Gift boxed Two pints Grade A in a sturdy, re-usable wooden box Sliding lid, mortised corners $12.75 plus $3.00 shipping, $4.00 West of Miss New Morning Farm Bethel, Vermont 05032

Government Surplus

GOVERNMENT SURPLUS DIRECTORY Buy 500,000 items (including Jeeps) low as 2¢ on dollar! Most complete information available—$2.00 Disposal, Box 19107-RY Washington DC 20036

JEEPS, CARS FROM $35.00! 700,000 Items! Government Surplus—Most Comprehensive Directory Available Tells How, Where To Buy—Your Area—$2—Moneyback Guarantee—"Surplus Information Services," Box 2238-DC11, Santa Barbara, California 93120

Merchandise/Gifts

AGATE WINDCHIMES, Kaleidoscope, full color catalogue of the most unusual artistically designed gifts using agate in the United States $2.00 refunded The Touchstones Collection, P.O. Box 2068N, Boulder, Colorado 80306

EDELWEISS PLANT of nostalgia and romance, perennial for garden or pot $15, seeds $10, flower $5, dry arrangement $25 ppd. Szarotka, P.O. Box 366, Portland, OR 97207

FOR THOSE TO WHOM you never know what to give. Beautiful handmade keyrings, wildlife designer bookmarks and stickpins. Send $1.00 (refundable with first order) for catalogue to. Gem An Eye, 27-26 Jackson Avenue, L.I.C., NY 11101 (212) 786-2410

FREE CATALOGUE—Peoplefeeders and birdfeeders. James Lockhart prints, Austrian backscrubbers, recreation room and home bar items. Quality merchandise and distinctive gifts from: The Armchair Emporium Ltd., 825 Surrey Lane, Dept. NH7, Algonquin, IL 60102

HANDWOVEN WOOL RUGS in lightfast plant colors and natural fleece yarns. $6.00 square foot. Color brochure. Harvest of the Spirit, 803 S. Hall, Grangeville, ID 83530

HOLOGRAMS! Beautiful, sharp 3D images of chambered nautilus or spiny murex shell. Unique Xmas gifts $22, framed. Sundog Holographics, 7801 Holmes Run Dr., Falls Church, VA 22042



I'm Wild About Life ©

This nature loving tote is 15 x 17 beige canvas with brown silk screen lettering. Strap fits over arm or shoulder. Ideal for any safari.

Peri Winkle Print
P.O. Box 269
Bohemia, N.Y. 11716

$ 9.95
Postage
$ 1.50

JIGSAW PUZZLE, MAP OF KENTUCKY—$10—Simmons Puzzle Co., Box 135, Greensburg, KY 42743

NATURE POST CARDS—Close-up color photos of birds and animals. Beautiful & educational. $8.97 for 111, all different. Birds, Animals, plus all our other Nature Cards, 176 cards for $12.00. (Not retailed to Illinois addresses. Wholesale rates available all states.) Nature Press, 628 E. 20th St., Alton, IL 62002

PURCHASE Bowie, Civil War knives, Indian tomahawks. Robert Abels, 2881 N.E. 33 Court, Fort Lauderdale, FL 33306

Miscellaneous

BIORHYTHM CHART. 80-day Computer chart. Send 50 cents, Name, Address, Birthdate. WB Enterprises, P.O. Box 29741, Los Angeles, CA 90027

TRINITARIANS. Catholic Priests, Sisters, Brothers, praying, working to end violence. Write: Father Joseph, 110 Greyrock, Garrison, MD 21055

Music

RECORDS-TAPES! Discounts to 73%. All labels; no purchase obligations; newsletter; discount dividend certificates. 100% guarantees. Free details. Discount Music Club, 650 Main street, P.O. Box 2000, Dept. 25-1181, New Rochelle, NY 10801



Fruit stand on the island of Corfu

Jim Hollander

Please send me information regarding the tours I have checked.

- ☐ **Archeology Tour to Mexico** January 11 to 29 1982
- ☐ **Ancient Maya Archeology** February 1 to 18 1982
- ☐ **East African Safaris** February 3 to 21 1982
  February 24 to March 14 1982
- ☐ **Nile Cruise** February 7 to 27 1982
- ☐ **Indonesian Odyssey** February 21 to March 13 1982
- ☐ **Art and Archeology Tours to China** March 23 to April 15 1982
  April 7 to May 3 1982
  September 16 to October 13 1982
- ☐ **Anthropology Tour to Morocco** April 4 to 17 1982
- ☐ **Galapagos Islands Cruise** June 6 to 17 1982
- ☐ **Alaskan Wildlife Adventure** June 25 to July 12 1982
- ☐ **Adriatic and Aegean Adventure** August 31 to September 16 1982
- ☐ **1982 General Program**

American Museum of Natural History

Discovery Tours

Central Park West at 79 St
New York, NY 10024
(212) 873-1440

Name (please print) _____

Address _____

City _____ State _____ Zip _____

No Postage
Necessary
If Mailed
In The
United States

Business Reply Card
First Class Permit No. 2984 N Y , N Y

postage will be paid by



American
Museum of
Natural
History

Discovery Tours

Central Park West at 79th Street
New York, New York 10024

Old Time Radio

OLD TIME RADIO PROGRAMS on cassette tapes. Free catalogue. Cassette Library Center, P.O. Box 5331H, Baltimore, MD 21209

Optical

BINOCULAR SALES AND SERVICE. Repairing binoculars since 1923. Alignment performed on our U.S. Navy collimator. Free catalogue and our article "Know Your Binoculars," published in Audubon Magazine. Mirakel Optical Co., Inc., 331 Mansion St., West Coxsackie, NY 12192 (518) 731-2610

LEITZ, ZEISS, B&L, SWIFT, BUSHNELL, NIKON. Optolyth binoculars, telescopes and accessories. Send stamp for discount list. Specify literature desired. Large stock. Orders filled postpaid day received. Birding, Box 5N, Amsterdam, NY 12010

OPTIC DISCOUNTS: Binoculars—Telescopes—Brand Names—Free List. Thos. Manetta, Box 12, 61 Hoffman Avenue, Elmont, NY 11003

Personals

MEET SINGLES Mexico, Orient, Europe, Australia. Free information. Write: International, Box 1716-NH, Chula Vista, CA 92012

Photography

IRELAND: A PERSPECTIVE IN PHOTOGRAPHY. Five unique photographic images that dramatize the harsh, lyrical beauty of Western Ireland. Each print in this limited set is numbered and signed and includes notes from the photographer's journal. An unusual gift or addition to your collection. Set of five prints $100.00. Send check or money order to: David Blaisdell, 64 Stackpole Road, Somersworth, NH 03878

THE FLYING EAGLE®: Finest laser color reproductions of the ultimate Bald Eagle photograph. 16 x 20 Fine Art Print, $20. Kenneth R. Hunter, Ph.D., Egegik, Alaska 99579

Real Estate

FREE! Big Fall-Holiday Catalogue! Over 5,400 country properties described, pictured! Land, Farms, Homes, Businesses, Waterfront, Recreation, Retirement buys! Selected best thruout the U.S. Over 700 offices, 43 states. All Across America! Yours Free from the World's Largest! Strout Realty, Inc., 60 E. 42nd Street, Dept. 5390, New York, NY 10017

FREE . . . 296-PAGE CATALOGUE. Describes and pictures over 2,800 farms, ranches, acreages, businesses and town and country homes from coast to coast. United Farm Agency, Inc., 612-V W. 47th St., Kansas City, MO 64112. Ph. Toll-Free: 1-800-821-2599; MO. Res. Ph. Toll-Free: 1-800-892-5785

GOVERNMENT LANDS . . . FROM $7.50/ACRE! Homesites, farming, vacationing, investment! "Land Buyer's Guide" plus nationwide listings—$2.00. Lands, Box 19107-RY, Washington, DC 20036

Rentals

ABACO, BAHAMAS—3 bedroom seaside rental cottage—secluded tropical setting along deserted white sand beach. Coral reefs offshore with abundant marine/bird life. R. Pingeon, 401 E. 65th St., NY, NY 10021 (212) 794-0318

BRITISH VIRGIN ISLANDS. Virgin Gorda. Deluxe seaside villa rental. Fully equipped 3 BR, 3 BTH. Spectacular view. Private beaches. Write Hartley, 125 Barn Run Ct., Huntington Station, NY 11746

ST. JOHN, VIRGIN ISLANDS apartment for two. Vacation: swimming, snorkeling, exploring National Park. $325 weekly. Barsel, Box 114, St. John, U.S.V.I. 00830

Resorts

FAR OFF THE BEATEN TRACK. Very small, very special hotel tucked into a 30 acre plantation on the island of Bequia, St. Vincent Grenadines, W.I. 10 rooms, fresh water pool, beautiful beach, snorkeling, hiking, photography, birding, tennis. Write or call: Spring on Bequia, Box 19251, Minneapolis, MN 55419, (612) 823-1202, or your travel agent. Member of Distinguished Inns and Historic Hotels.

NEW MEXICO. Guided tours—wildflowers, birds, prehistoric dwellings. Bear Mountain Ranch, Silver City, NM 88061 (505) 538-2538

VACATION/RELAXATION—Birdwatcher's delight—Peaceful, secluded nature lover's mountain retreat. Cave Creek Ranch, Portal, Arizona 85632

Tours/Trips

ADIRONDACK WILDERNESS SKI TOURS: Enjoy the exhilaration and beauty of a northern winter in the company of expert naturalist guides. Cross-country ski vacations are five days, limited to 12 guests. Day trips into "forever wild" Adirondack Forest Preserve. Explore habitats of deer, beaver, bobcat, coyote, bear, fox, otter, pine marten, fisher, mink. Evenings spent in cozy backcountry lodge enjoying hearty homecooked meals, good company, and fireside programs with noted ecologists, historians, photographers, and conservationists. Write: Adirondack Ski Tours, McMaster Rd., Saranac Lake, NY 12983. Or call: (212) 546-9202

ADVENTURE TRAVEL: Tanzania Camping Safaris, Peru natural history, Himalayan Treks, Australian Adventures. Special birdwatching and natural history departures. Overseas Adventure Travel, 1430 Mass. Ave. #303N, Cambridge, MA 02138 (617) 876-0533

AFRICA: KENYA & TANZANIA. Top quality wildlife safaris. Winter and summer departures. Also: Galapagos Islands, Ecuador, Peru, Patagonia, the Amazon and Nepal. Very small groups. Expert naturalist leaders. For free illustrated catalogue, write: Wilderness Travel, 1760-CA Solano Ave., Berkeley, CA 94707 (415) 524-5111

AMAZONAS ADVENTURES: Explorer's Inn (Peru). Amazon Lodge (Brazil). Orellana (Ecuador). Chapare (Bolivia). Day/overnight jungle expeditions/cruises. Combinable with 155 other South America programs. Forum International, 2437 Durant, Berkeley, CA 94704 (415) 843-8294

BIRDS AND MAYA RUINS: 2-week special trip with Princeton's Stony Brook-Millstone Watersheds Assn., March 14-28, 1982 to Mexico's Yucatan and Palenque. Four guides, deluxe accommodations, relaxed pace. Tropical birding at its best. Call or write: Princeton Nature Tours, 282 Western Way, Princeton, NJ 08540 (609) 924-5258

BIRDING CALIFORNIA, Baja and west coast Mexico with Dr. Dennis Paulson. Washington wildflowers. X-C British Columbia. Alaska and Hawaii. Brad's Tours, 401 E. Mercer 31D, Seattle, WA 98102

CARNIVAL IN BRAZIL. Attend Bahia's extraordinary, African-influenced pre-Carnival festivities + 7 days sailing Brazil's magnificent coast. Unique anthropological adventure. Write: Wilderness Travel, 1760-CB Solano Ave., Berkeley, CA 94707

DISCOVER BAJA! Join professional naturalists & crew for ocean going exploration of Baja's wilderness islands and lagoons. Gray whales up close, elephant seals, superb birding & lots more! Excellent photo opportunities, small groups. Color brochure. Pacific Adventures Charter Service, 2445 Morena Blvd., Suite 200H, San Diego, CA 92110

ECONOMIC GALAPAGOS. Weekly departures. Seven or fourteen nights in Galapagos with optional Ecuador, Amazon, Peru. University credit available; non-students welcome. Dr. R. Lainhart, Biology Dept., Towson State University, Towson, MD 21204 (301) 321-2443 or 922-3116

FASCINATING NATURE/LEGENDARY CULTURES. Usual and unusual travel programs to Latin America, Africa, Mideast. Features Machu-Picchu overnights, Amazon, Galapagos, Madagascar, etc. Groups/Individuals. Reasonably priced. Forum International, 2437 Durant, Berkeley, CA 94704 (415) 843-8294

FLIGHTS OF FANCY. exclusive weekend fly-in adventures designed to tempt the Aristocratic you. Blue Sky Adventures, Piper Division, Oak Ridge, NJ 07438 (201) 697-7233

GALAPAGOS HIKING AND SAILING EXPEDITIONS. Small groups. 1982 dates: February 4, April 22, July 7, August 4. Charters. Machu Picchu options and Chili ski options. Inca Floats. 5982N Balboa, Oakland, CA 94611 (415) 339-9095

INDIA/NEPAL WILDLIFE SAFARI: Outstanding game observation in three major reserves + Delhi, Taj, Kathmandu, Himalayas. $1375.00. Also, comprehensive program of trekking expeditions in Nepal's Everest & Annapurna regions from $895.00. Airfares additional. Free brochure. Himalayan Travel, Inc., Box 481-NH, Greenwich, CT 06830. Toll Free (800) 243-5330

NEW ZEALAND NATURAL HISTORY Trek and River Expedition, January and February 1982. Polynesian Island Trek & Tahiti Arts Workshop, December 1981. Write James Henry River Journeys, P.O. Box 807-M, Bolinas, CA 94924 (415) 525-6578

NEW ZEALAND WALKABOUT. A selection of escorted nature and hiking tours, featuring New Zealand's scenic National Parks, the Milford Track, Farm Holiday Stay. Pacific Exploration Company, Box 3042-N, Santa Barbara, California 93105

SAVE 50% ON CRUISES. Our members do. You can too. Details free. TravLtips Association, Box 188B5, Flushing, NY 11358

SERENGETI: MIGRATION OF WILDEBEEST. 1982 departures. Send for details. Overseas Adventure Travel, 1430 Mass. Ave. #303N, Cambridge, MA 02138 (617) 876-0533

WINTER-SPRING SAILING SCHOOL. French West Indies. Learn Navigation and Seamanship aboard 50' ketch 'Palisander'. Also Blue Water Cruises. Cuttyhunk Marine Adventures, 2809 Dumbarton Ave., Washington, DC 20007

WORLD OF THE MAYA. An extraordinary anthropological adventure to remote Mayan villages in southern Mexico. Crafts, carnival fiestas, ancient ruins. Very small group guided by expert anthropologist fluent in Mayan dialects. February, 1982. Write: Wilderness Travel, 1760-MC Solano Avenue, Berkeley, CA 94707

RATES AND STYLE INFORMATION

$1.75 per word, 16 word ($28) minimum. *Display classified* is $150 per inch. All advertisements must be prepaid. Rates are not structured for agency or frequency discounts. All advertisements are accepted at NATURAL HISTORY's discretion. Send check/money order payable to NATURAL HISTORY to: The Market, NATURAL HISTORY Magazine, Central Park West at 79th St., New York, NY 10024. Please include your personal address and telephone number, issue preferred, and suggested heading. Deadline—1st of month, two months prior to cover date (the January issue closes Nov. 1). Camera-ready art is required for display ads. A tearsheet or copy of the page with your ad will be sent upon publication.

Box numbers, telephone numbers, and hyphenated words count as two words; abbreviations and zip codes as one word each. All states are shown in two-letter code followed by zip, then telephone (with area code), if desired. Occasionally, slight editing is required for clarity. Thank you!



Carla Bauer

Pin Cherry Perceptions

The language we use in our investigations of nature affects the questions we ask and the answers we get

by Robert E. Cook

In late April and May, when birches turn New England's hillsides pale green and swamps grow pink with red-maple buds, the blossoms of pin cherry burst out in an umbrella of white-petaled flowers surrounded by a haze of honeybees. The rise of sap from the cherry's roots brings a reddish hue to the shiny black bark with its horizontal gray lenticels. The pin cherries are soon lost in the foliage of the summer forest, but they become prominent again in August when the ripening fruits draw late-nesting waxwings and flocks of migrating robins to harvest strings of cherries. Without much delay the birds process the sweet pulp and pass the stony seeds on to the forest floor.

Conspicuous members of the northern hardwood forests of the Northeast, pin cherries (*Prunus pensylvanica*) never grow very old, seldom living beyond thirty years in the forest. The biology of this short-lived species seems designed to rapidly produce a large number of single-seeded drupes, fleshy fruits with an inner stone that holds the seed. A young pin cherry may first show flowers only four years after germination, when it is barely a sapling. Peak yields occur between the ages of fifteen and twenty-five, and over its entire life, a healthy, free-growing female may form more than 32,000 drupes.

The fruiting pin cherries are often found thriving on land that has recently seen disturbance or destruction of the vegetation: about the edges of breaks and trails or scattered among the young oaks, beeches, and sugar maples that revegetate cutover land. The species is sometimes called fire cherry because its seedlings quickly occupy burned-over forests, where they may form a single stand of rapidly growing foliage. It also follows promptly in the wake of loggers, emerging through the piles of slash and raw stumpage within a year or two of the cut. As salvager of ravaged landscapes, the pin cherry has recently captured the attention of ecologists investigating the recovery of damaged ecosystems.

By the middle sixties, the growing alarm among environmentalists concerning the devastating impact of some human activities on wilderness areas had thrown the wisdom of forest clear-cutting into question. Clear-cutting is economically efficient: all the trees in a large tract of forest are cut to the ground, stripped of branches, and carried off to the sawmill. Many years later a new forest has usually replaced the old one through a revegetation process called succession. Ecologists asked whether the economically efficient practice of removing all the trees, rather than selectively cutting choice individuals, might adversely affect the pattern of subsequent forest recovery and permanently damage the land. They were particularly concerned about any decline in soil fertility—the capacity of the deep layers of humus to provide the mineral nutrients needed for the growth and development of later forests. In mature stands, much of the nutrient capital, such as nitrogen, potassium, and calcium, can be tied up in living plant tissue or intimately complexed with the decomposing layers of organic matter on the forest floor. Ecologists wondered whether, in addition to the minerals that depart with the harvested timber, clear-cutting might cause a loss of nutrients through erosion and excessive runoff in stream water.

Herbert Bormann of Yale's School of Forestry and Environmental Studies and Gene Likens of Cornell University decided to test these ideas, and in 1964 they established the Hubbard Brook Experimental Watershed Study on a tract of second-growth hardwood forest in the White Mountains of central New Hampshire. The experimental unit they manipulated is known as a watershed, an area of forest draining into a single stream. Two adjacent watersheds at the headwaters of Hubbard Brook were chosen: one was to be clear-cut for the experiment and the other, the control, was to be left uncut. By constructing a notched dam, or weir, at the head of each stream, they could measure stream flow from both watersheds and periodically sample the water to assess nutrient content and the loss of particulate matter from erosion. All the trees in the experimental watershed were cut, and the effects of devegetation were accentuated by the application of herbicides for three years. After the cut, Bormann and Likens, and their students, monitored the water chemistry and the change in the growth and composition of

DINOSAURS OF NORTH AMERICA

"brings back to life the very different world of the distant past—with its exotic and spectacular creatures."
—John H. Ostrom, Curator of Vertebrate Paleontology, Peabody Museum of Natural History, Yale University



Now, in the most authoritative book of its kind—and the first devoted exclusively to North America—Helen Roney Sattler describes more than 80 kinds of dinosaurs that roamed the continental United States and Canada. For 140 million years, dinosaurs dominated the earth. The fossils they left help us to know what they really looked like, from the gigantic *Brachiosaurus*, 40 feet tall and 80 feet long, to *Nanosaurus*, about the size of a chicken.

Dinosaur history is told against a background of vast geological changes. Included is information about exciting discoveries being made today and the latest theories about what caused dinosaurs to become extinct. For future fossil hunters, this book is a must. For everyone, reading it will be an adventure.

DINOSAURS OF NORTH AMERICA
text by **Helen Roney Sattler**
illustrated by **Anthony Rao**
Ages 8 up $10.95

FREE DINOSAURS poster available. To get your free 13½" x 15½" Stegosaurus poster write to:

Lothrop, Lee & Shepard Books
A division of William Morrow & Co., Inc.
Dept. CM-D
105 Madison Avenue, New York, N.Y. 10016

the cut forest and compared this with the control.

Bormann and Likens have recently published the results of this experiment in *Pattern and Process in Forested Ecosystems* (New York: Springer-Verlag, 1979), and it is a brilliant piece of ecological investigation. In an effort to achieve a broad understanding of forest systems, they have constructed an ecosystem model based on the Hubbard Brook data to predict the recovery of a forest following the devastation of its vegetation. In this model, the ecosystem—all of the dead and living organisms as well as the inorganic nutrients—is pictured metaphorically as a highly integrated organic entity that is subjected to a serious wound or disturbance, much like a severe injury suffered by an animal. The entire system undergoes a process of recovery (succession) in which internal homeostatic mechanisms repair the damage and return the system to a normal state. Bormann and Likens divide their model of forest recovery into four phases: an early period of declining biomass through the decomposition of dead slash; a hundred years of succession as biomass accumulates; a transition time when old trees begin to die, creating local gaps of disturbance; and a long-term steady state when the forest is a mosaic patchwork of mixed-age trees in different stages of succession. The goal of this recovery process is the original plant community that covered the landscape prior to the intrusion of humans. This image of a primeval forest has haunted plant ecologists for more than half a century, touching their deepest feelings for unspoiled wilderness. Armed with this conceptual model and its underlying organismic metaphor, Bormann and Likens set about interpreting the remarkable results of their deforestation experiment.

The most fundamental effect of clear-cutting was a dramatic increase in the volume of stream flow, particularly during spring snowmelt and after heavy rainstorms. One midsummer shower in 1969 generated a peak flow that was more than three times higher in the cutover watershed than in the control. Precipitation, which would normally have been absorbed through the roots of living plants and transpired via evaporation into the atmosphere, moved out of the watershed in a massive flush of water accompanied by enhanced concentrations of nutrients. Dissolved nitrogen, for example, which is so critical to the growth of plants, peaked nearly 160

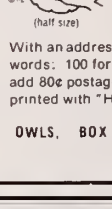
Wildlife Adventures

- Whale Watching in Mexico
- Polar Bear Photography
- Tanzania Wildlife Safari
- Gorilla Viewing in Congo

Many other trips

Travel in small groups with the experts

For 81 82 Preview & itineraries contact
Adventures International
4421-AS Albert St.
Oakland, CA. 94619 (415) 531-6564



(half size)

Custom Printed OWL Stickers

This bright yellow Owl sticks at a touch to paper, leather, wood, glass, plastic, cloth or metal. Carefully printed in clear, readable type and cut to Owl shape.
With an address, a short message or just a few words: 100 for $5.90 or 200 for $8.70. Please add 80¢ postage and handling. Also, 20 Owls printed with "Have a Nice Day" for $1.40 ppd.

OWLS, BOX 735-T, ACTON, MASS. 01720

Nature & Cultural Expeditions



Combine adventure, discovery, learning and vacation on nature, cultural and photography expeditions worldwide!

Join small groups interested in Baja California . . . Alaska . . . Galapagos . . . Japan . . . Bhutan . . . China . . . Nepal . . . Polynesia . . . Tanzania . . . Scotland . . . and more than 25 other unique areas worldwide led by experts in anthropology, natural history or photography.

For complimentary brochures and itineraries write

Nature Expeditions International
599 College Ave. • Dept. N • Palo Alto, CA 94306 • (415) 494-6572

For the eighth year, we invite you to witness North America's greatest wildlife spectacle:

The Seals on the Icepack

MARCH 4 to 9, and MARCH 8 to 13, 1982

Each year, thousands of seals end their migration in Canada's Gulf of St. Lawrence and congregate on the icepack, turning it into a huge natural nursery as the females give birth to their babies.

We are the only company in the world with the experience, knowledge and audacity to offer these unique, thrilling and exhilarating tours.

Detailed brochures of the tours and a copy of our newsletter which lists all our fascinating travel programs, available from:

HANNS EBENSTEN TRAVEL, INC
705 WASHINGTON STREET, NEW YORK, NY 10014
TELEPHONE (212) 691 7429

times higher in the stream flow of the devegetated watershed than in the forested area. The authors concluded that "the ecosystem responds to enforced devegetation by dumping substantial quantities of nutrients into drainage water." Much of this loss of minerals derives from the decomposition of dead and dying vegetation on the forest floor. Equally important, however, is an increase in the erosion of soils throughout the watershed. Particulate matter in streams is proportional to the flow of water, and in the first three years after the forest was cut, the forest floor actually sank three centimeters in depth.

This stark picture of system degradation changed dramatically as soon as the herbicide treatments ceased and the vegetation was permitted to grow. Within four or five years the concentration of dissolved nutrients in the drainage water was close to that of the uncut watershed, particulate matter was significantly reduced, and in general, stream flow during the summer months began to approach the small volumes normally trickling out as forest ground water in midsummer. When vegetation returns after clear-cutting, foliage quickly overgrows the cut stumps and decaying piles of litter and fresh roots proliferate in the soil, consolidating the crumbling humus against erosion and absorbing ground water rich in nutrients. Precipitation percolates out of the watershed through the plants, moving upward in conducting vessels to the surface of the leaf and leaving through stomatal evaporation. During this passage, the plant extracts minerals critical for growth. This solid stream of water within the mass of the shoot provides the force for plant growth by increasing the turgor in new cells at the growing tips, expanding cell walls and slowly unfolding new leaves. Vigorously developing plants live much like fish in a stream, depending on the flow of water to provide continual support and sustenance.

Herein lies the short-lived but exalted glory of pin cherry, for in many New England forests, it is the primary species responsible for this dramatic turn of events. Its influence is felt so quickly because it really begins living in the forest—in the form of dormant seeds in the soil—long before a cut. There may be as many as fifty pin cherry seeds in each square meter of forest loams. In the Northeast, many of these individuals have probably been leading quiet lives since the last flush of cherries followed the lumbering of the forests soon

FROZEN STIFF?

It's 10° outside . . . Even getting colder. So you bundle up in layers and layers of heavy clothes. First with long underwear . . . then bulky, restrictive thermalwear on top.

Oh, you were warm all right. Like in a Turkish bath. Because you began to perspire from all your activity. And perspiring in that mountain of clothes is like perspiring in a plastic bag! The perspiration is locked in. So there you are. Wet and miserable.



But now, at last, Damart has solved the problem. Because Damart invented underwear that keeps you *warm, dry and comfortable* no matter how cold it is or how long you stay out. Underwear that's soft and light so you can move easily. Underwear knitted to let the *perspiration evaporate through* so you always stay warm and dry next to your skin. Nothing else does this like Damart!

Damart does this with a new miracle fabric—Thermolactyl. You can wear Damart indoors too, and turn your thermostat down into the 60's. You'll feel perfectly comfortable and enjoy dramatic savings in home heating costs.

Damart is so comfortable that the Mt. Everest climbing expedition wears it. So does the Chicago Bears Football Club, New England Patriots and Philadelphia Eagles.

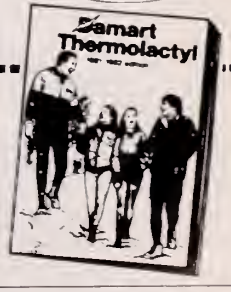
Our free color catalog tells the full Damart Thermolactyl story and displays the whole Damart line for men and women, *including tall sizes.* Send for your FREE copy now!

THE PROOF IS IN THE WEARING

Damart Thermawear

Limited Warranty to Consumers ★ Good Housekeeping Promises Replacement or Refund if Defective

WHEN IN THE BOSTON AREA, VISIT OUR PORTSMOUTH, N.H. STORE. (603) 431-4700



THERE IS NO WARMER UNDERWEAR MADE!

Fill out and send to:

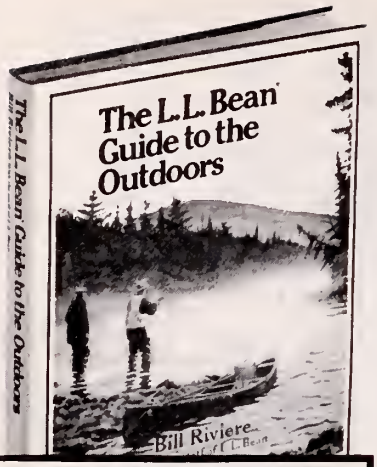
DAMART, Dept. 12751
1811 Woodbury Ave.
Portsmouth, N.H. 03805

YES! Rush me your **FREE DAMART** Catalog . . . I want to enjoy the fantastic warmth of Thermolactyl Underwear, a DAMART® exclusive. (I understand there is no obligation.)

PRINT NAME

ADDRESS

CITY STATE ZIP © 1981, Damart



At last—from the folks who know the outdoors best—

The most authoritative and complete guide ever written to getting on—comfortably and safely—in the outdoors

by BILL RIVIERE

with the staff of L. L. Bean

Illustrated. $15.50, now at your bookstore

RANDOM HOUSE

ELECTRONIC BARGAINS

3-MELODY QUARTZ ALARM CLOCK

$19.95 ea.



Plus $1.50 handling & Shipping.

• Displays hours; minutes, month & date • Alarm indicator • Quartz control for accuracy • Night light • Pull-out stand • Unique slide-out bracket for car or desk use • Batteries included • Snooze alarm mode • 2-5/8"x1-3/8"x3/8" • Perfect gift for the traveler • Black case with brush metal face

LCD DIGITAL WATCH PEN

LCD Quartz • Displays hours, minutes, seconds, date and month • Battery included • Takes parker size refill • Slim design - only 9mm thick • Silver-tone finish 15 day full-refund guarantee

$15.95 ea.

Plus $1.50 handling & Shipping



CORPORATE INQUIRY WELCOME.

CALL TOLL FREE

1-800-257-7850 Op. 653

NEW JERSEY 1-800-322-8650 Op. 653

NEW YORK RESIDENTS ADD SALES TAX

M.C., Visa Cards accepted. Please give card No. & Exp. date or send check or M.O. to:

COLUMN ONE MARKETING, INC.

21-03 41st Ave.

Long Island City, N.Y. 11101 N

after the turn of the century. Others have arrived more recently with the passage of birds. The cutting of the trees leads to the massive germination of these seeds and the rapid transformation of the decomposing litter into a garden of seedlings. Pin cherries display one of the highest growth rates of the prominent forest species, forming a closed canopy of knee-high saplings within a year or two of release from life as a seed. Fruit production soon begins, and the high fragrance and spring blossoms of *Prunus pensylvanica* will command the canopy for the next twenty years.

Pin cherry eventually relinquishes the stage to other hardwood species, such as beech, yellow birch, and sugar maple, that dominate the uncut forest. Bormann and Likens drew their account of pin cherry biology from the work of Peter Marks, a plant ecologist at Cornell who studied extensively in the Hubbard Brook forest. Marks found small saplings of the future hardwoods, which had apparently survived the lumbering, growing in the midst of a thicket of pin cherry seedlings within a couple of years after the start of revegetation. Thus all the individuals in the succession are present at the beginning. Mortality among the dense cherry seedlings is extremely high, with only one out of twenty-five reaching the age of peak reproduction. Individuals of beech and maple fare much better than the smaller cherry plants because they can tolerate the deep shade cast by the overstory. These small hardwoods achieve some marginal growth each year, and by the time they penetrate the canopy, the oldest pin cherries have begun to senesce, freeing space for the emerging hardwoods. With time the forest's original composition is restored.

The coincidence of the cutting of the forest and the massive germination of pin cherry seeds is striking. Equally remarkable is the relationship between the high growth rate of these seedlings and the recovery of control over the export of nutrients through ground water. Finally the deposition of a new population of seeds through abundant fruit production appears to renew the potential for a similar response in the future. Bormann and Likens find this biology so persuasive that they call it the buried seed strategy and assign it a critical function in their forest model. The adaptations of pin cherry—its dormant seed populations, simultaneous and rapid germination, high rate of growth, abundant fruiting, and early senescence—are interpreted in their model as part of a plan

Leitz TRINOVID

Our finest binocular?



Compact, precise, they give you sparkling crisp clarity and exceptionally true color rendition

Many people consider them the finest you can buy Because most of them already own Trinovids Find out why

Write to the "optics headquarters for the bird watcher" for literature and deep discount prices

BIRDING P.O. BOX 5-HI AMSTERDAM, N.Y. 12010

Mystery Electronic Top

Greatest New Gadget In Years



Handsome Gift Box

Spins for days on Invisible Power

Unique Christmas Gift

What Makes It Go On and On at 2500 r.p.m. with no apparent energy source? **BAFFLING BRAIN BUSTER that BUGS the BRIGHTEST.** The higher their IQ the more puzzled they are. Examine it, start it, stop it or whatever. **Perpetual Motion solved at last? Psychic Power? Anti-Gravity? Scientific Breakthru from Space?** The answer to spaceships & UFO's? Magic, Mystery & Science combined. Entertain friends & fool wise guys. Spins for days on **Invisible Wireless Power that you can defy anyone to See, Understand or Explain!** Beautifully made with plastic base and saucer-shaped spinner. Practically indestructable. Secret scientific explanation included. **Orders shipped promptly. Money Back Guarantee. Send check or money order for $9.95 each. Add $1.25 shipping & handling. Save: Get 3 for $28.50 plus $1.50 shipping; 6 for $53.75 plus $2.00 shipping. Master Charge or Visa accepted by mail or phone. Give card number & expiration. Phone: (313) 791-2800. Johnson Smith Co., Dept. 7211,Mt. Clemens, Mich. 48043.**

New Natural Way To Sleep



Pure Cotton Knit

Tee-PJ's resemble a T-shirt, but over a foot longer. Special knit gives when you move, eases up when you relax. No bind, no bunch, no chafe, no buttons, no ironing! Most comfortable sleeper you've ever worn or money back. (Great for Ladies, too). Choose snow white or soft blue. S-M-L-XL (to ensure best fit include height-weight when ordering.) Order NOW, while prices include postage/handling!

$12 ea 3 for **$26**

Long sleeve style (not shown)

$15 ea 3 for **$35**

WITTMANN TEXTILES

Dept. 417, Hobe Sound, Fla. 33455

EXPLORE DARWIN'S

GALAPAGOS



THE BUCCANEER

"Largest Galapagos ship"

Cruises from $477 Plus Air Fare

All outside Air conditioned Staterooms, Private baths. Includes all meals aboard. Shore excursions conducted by multi-lingual naturalist guides.

Also visit **MACHU PICCHU, THE AMAZON, QUITO, LIMA, CUZCO, IQUITOS** on new low air fare

Write for brochures, deck plans, tariffs, itinerary

GALAPAGOS, Inc.

Suite 112-C, 7800 Red Road, So. Miami FL 33143

Name _____

Address _____

City/State/Zip _____

for recovery of the ecosystem following catastrophic destruction. The "behavioral patterns of species using this strategy," they write,

> suggest that it may have evolved specifically in response to the highly specialized conditions that follow serious disturbance of a previously intact ecosystem. In terms of system dynamics, the strategy is not simply exploitation of an injured ecosystem but is also part of an elaborate feedback mechanism that acts rapidly to limit temporarily accelerated nutrient export and return the system to a condition of greater stability.

At the risk of being picky, we can ask whether an ecosystem, the ensemble of living organisms and associated mineral constituents, can become "injured." Has pin cherry evolved dormant seeds to "limit . . . nutrient export . . . and return the system to . . . greater stability," as implied in the quote above? Ah, you say, this is but a figure of speech, not to be taken literally. At this point readers may accuse me of getting stuffy about language and metaphor in science. I plead guilty to the charge of extracting a single quote, out of an exceptional work of scholarship, upon which to hang a fine distinction, and I ask the reader's indulgence while I try to delineate an important matter of interpretation.

What's wrong with an organismic metaphor lying within the model of forest recovery? After all, an ecosystem behaves *as if* it were a living organism. And, by analogy with an organism, it appears to have a mechanism of self-repair, a healing process that leads to the return of normal function. Why couldn't a process much like the capacity for tissue reconstruction in the individual have evolved in the ecosystem? Does the choice of the language with which an abstract model is constructed have any effect on the quality of the science?

I am as susceptible as anyone to the intuitive beauty of a finely chosen metaphor in any medium. The problem arises when our metaphors take on a life of their own and become so deeply rooted in our minds that they generate fundamental misconceptions about nature. Metaphors do more than affect how we understand our perceptions; they actively shape the kinds of questions with which we approach our ignorance. Once passed on to our students, metaphors truly acquire independent flight, free from the contextual qualifications that accompanied their birth.

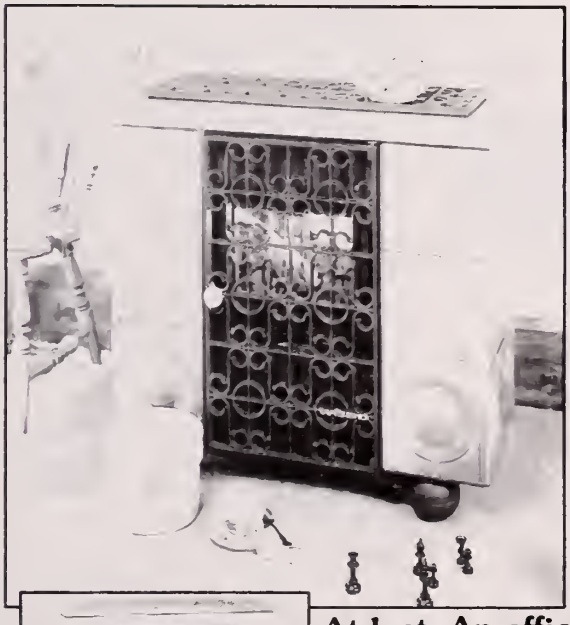
Perhaps the question of ecosystem evolution can be clarified through appli-

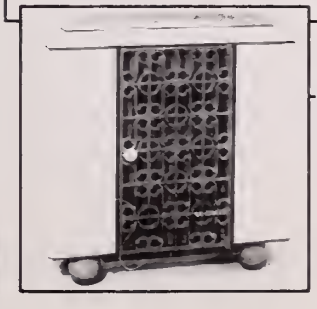
The original Teddy Bear. Handcrafted in Germany since 1903. Available at fine toy and department stores.

Steiff
BUTTON IN EAR



A lifetime of love.





Kăch-ĕl-ōfen.

Kachelofen. Fashioned by skilled artisans of masonry and ceramic tile, these stately, magnificent central heaters have warmed Alpine homes for 700 years. Housed in museums and castles throughout Europe, they are viewed as national treasures.

The WESO Ceramic Tile Stove from Germany is a direct descendant of Europe's mighty kachelofens. The WESO's cast-iron firechamber is surrounded by thick, hand-glazed ceramic tile which captures and releases the fire's warmth far better than metal could.

The WESO burns wood or coal and offers every efficiency feature you could ask for. Its beauty is breathtaking. Choose from 7 decorator tile colors, and enjoy the WESO's visible fire and all-over warmth.

At last. An efficient woodstove beautiful enough for your home.

Rush me your literature portfolio by first class mail, featuring the WESO in all seven tile colors, complete performance data, details on WESO's new coal stove, and current shipping schedule. Enclosed is $1 to help cover mailing costs.

Name _____

Address _____

Zip _____

Ceramic Radiant Heat 291B Pleasant Dr. Lochmere, N.H. 03252
603/524-9663

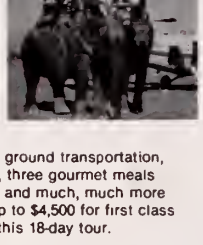
A PHOTO SAFARI TO REMEMBER

India & Nepal

JANUARY-FEBRUARY, 1982



Come and experience a world of color fantastic places • magical names • exotic game • majestic mountains • erotic art • magnificent architecture



Visit Old & New Delhi • the Taj Mahal • Tiger Tops resort in Nepal • the Ghana Bird Sanctuary or Bandogarh and Kanha big game and tiger sanctuaries • Pink city of Jaipur or the Erotic Temples of Khajuraho • Shop in the famed oriental bazaars.

ALL INCLUSIVE of air, ground transportation, hotels, jungle lodges, three gourmet meals (continental & oriental) and much, much more from $2,700 for coach up to $4,500 for first class all the way on this 18-day tour.

ACT TODAY — RESERVATIONS LIMITED!

SEND OR CALL TODAY FOR COLOR BROCHURE WITH ALL PERTINENT DETAILS & INFORMATION

CORPORATE TRAVEL & TOURS
21335 MARY LYNN DRIVE, WAUKESHA, WI 53186

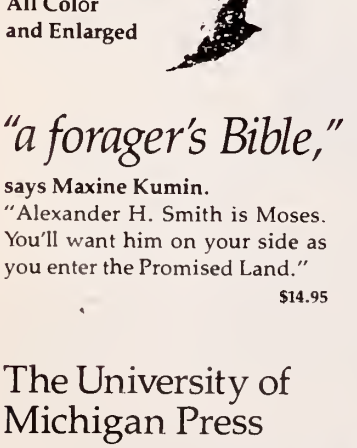
NAME: _____

ADDRESS: _____

CITY|STATE|ZIP: _____

CALL TOLL FREE 800-558-4355
IN WISCONSIN CALL 414-784-8430

Alexander H. Smith and Nancy Smith Weber



The Mushroom Hunter's Field Guide

All Color and Enlarged

"a forager's Bible,"

says Maxine Kumin.

"Alexander H. Smith is Moses. You'll want him on your side as you enter the Promised Land."

$14.95

The University of Michigan Press

Dept. A P.O. Box 1104 Ann Arbor MI 48106

cation of a simple Darwinian test to the biology of pin cherries. Most evolution occurs through natural selection, which causes an increase in the frequency of those inherited traits that allow individuals to leave relatively more offspring in future generations. In many instances these traits of individual organisms will also promote some ecosystem process, such as the recovery of nutrients from ground water. But suppose, for a moment, that a mutation occurred in a pin cherry seedling that decreased the efficiency or rate of recovery of an injured ecosystem but had the effect of increasing the number of future grandchildren descended from this individual. For instance, I can imagine a gene that channels energy into greater fruit production at the expense of an expanding canopy. Would such a gene spread through the population, decreasing the rate of transpiration and ecosystem recovery? If it increased the fitness of the individual cherry tree, we can say that it would, with high probability, soon characterize all the pin cherries in the population. Similarly, a gene that caused individual trees to leave relatively fewer descendants than neighbors would never increase in frequency, independent of its effects on ecosystem recovery. The appearance of adaptive order in the properties of the whole ecosystem—homeostasis, feedback recovery, stability—is just that, an appearance of design.

I suspect my colleagues who study ecosystems may still prefer a holistic vision of system stability. The quality of the science in the Hubbard Brook study is not in question here. Bormann and Likens have constructed a piece of research that is brilliant, synthetic, and rigorous, and it will surely prove immensely important for predicting the long-term effects of disturbance on natural habitats. At issue is the way we choose our conceptual language while creating our interpretations of nature. As the great geneticist Theodosius Dobzhansky said, nothing in biology makes sense except in the light of evolution. Should not the figurative language with which we dress our perceptions at least harmonize with the principle of natural selection? To do so, the words we choose must reflect the perspective of the individual, whose growth and reproduction are the gist of fitness. Ecosystems evolve only as their constituent organisms live and die, and our sense of adaptive design is only a mirage.

Robert E. Cook is associate professor of biology at Harvard University.

The Wilderness Travel World of Discovery



WINTER/SPRING NATURE TOURS TO:

• Kenya • Tanzania • Galapagos • • Costa Rica • Ecuador • Peru • • Falkland Is. • Patagonia • The Amazon •

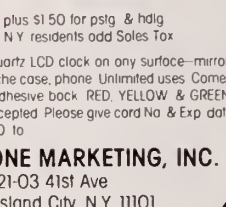
Expert Naturalist Guides Very Small Groups
Write for free illustrated catalog

WILDERNESS TRAVEL
1760-GP Solano Ave., Berkeley, CA
(415) 524-5111 94707

STICK-ON CLOCK

5-FUNCTION DISPLAYS:

- HOUR
- MINUTE
- MONTH
- DATE
- SECOND



ONLY

$8.50 ea plus $1.50 for pstg & hdlg
N.Y. residents add Sales Tax

You can stick this Quartz LCD clock on any surface—mirror car dash, refrig. attache case, phone. Unlimited uses. Comes with battery & self adhesive back. RED, YELLOW & GREEN. M.C. & Visa cards accepted. Please give card No. & Exp. date or send check or M.O. to

COLUMN ONE MARKETING, INC.
21-03 41st Ave
Long Island City, N.Y. 11101

BOOK HUNTING?

Virtually any book located—no matter how old or long out-of-print. Fiction, nonfiction. All authors, subjects. Name the book—we'll find it! (Title alone is sufficient.) Inquire, please. Write: Dept. 71

BOOKS-ON-FILE P.O. BOX 195
UNION CITY, NEW JERSEY 07087

For the fifth year, we invite adventurous travelers to join us on a unique travel experience:

The Snows of Kilimanjaro

FEBRUARY 5 TO 22, 1982

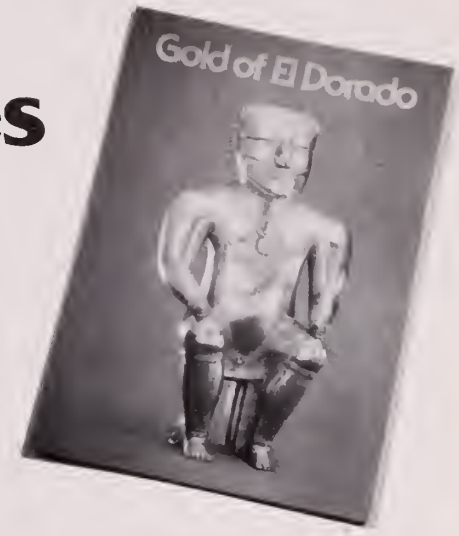
Our expedition begins with a wildlife safari to Ngorongoro Crater, the Serengeti Plains and Lake Manyara, where we also undertake hikes to prepare us for the ascent of Africa's highest mountain, crowned with its permanent icecap.

In order to make the climb not only memorable but enjoyable, we allow plenty of time for resting at huts and camps to become used to the high altitude.

Detailed brochure of the expedition and a copy of our newsletter which lists all our fascinating travel programs, available from:

HANNS EBENSTEN TRAVEL, INC
705 WASHINGTON STREET, NEW YORK, NY 10014
TELEPHONE (212) 691 7429

An Art Book That Took Centuries To Create



It took the American Museum of Natural History four years to arrange its exceptional exhibition of more than 500 pieces of ancient gold from Colombia. But those few years are a brief time when compared with the decades archeologists have spent digging (literally!) and studying the gold artifacts from tombs, caves, and buried sites. And all that time is short when compared with the many centuries prehistoric Indians practiced their craftsmanship and artistry to create these treasures.

So when it became the United States sponsor for this outstanding collection, the American Museum faced a dilemma. Could we do justice to all this effort and scholarship and beauty? We think we have. First, by dramatically displaying *Gold of El Dorado: The Heritage of Colombia* in one of our largest halls. The glowing reports from visitors tell us our efforts have been worthwhile. If you don't have a chance to see the show for yourself in New York, we hope you will see it in Chicago, San Francisco, or New Orleans on its year and a half tour.

The second challenge for the American Museum was the creation of an appropriate book to accompany the exhibition. We decided against a traditional catalog; against a small, boring volume with tiny black-and-white pictures that could never do justice to these fine objects. Instead, we decided to present a select number of the finest pieces of pre-Columbian gold in a large, stunning format. And to represent the three important elements that make a great art book we chose outstanding professionals.

First, photographer Lee Boltin. One of the greatest photographers of art objects, he also took the famous pictures of the Tutankhamun show. We sent him abroad to find and record great pieces of pre-Columbian art.

Second, archeologist Warwick Bray, from the University of London. One of the world's foremost authorities on pre-Columbian art, Bray is also a skilled writer, able to present fascinating background in a succinct, readable essay in the book. Dr. Bray organized the Colombian gold exhibition in London.

Third, Harry N. Abrams, Inc., America's leading publisher of fine art books. In a co-publishing venture with the American Museum, Abrams designed the book, supervised the preparation of 30 large color plates, and monitored the fine-quality printing.

The result is an unprecedented exhibition book. It is bold and big—each plate is 16 by 11½ inches—bigger than this magazine opened up. The paper is heavier than most posters. In fact, many persons have purchased two copies of the book in order to have one set of these fine art prints for framing.

And now for the happy ending. Because the Museum is a co-publisher, we are able to offer this soft-bound art book at a major savings from its normal retail price of $12.50. We are pleased to offer *Gold of El Dorado* to subscribers for only $6.25—a 50% savings off its regular price. This special offer is valid only during the exhibition and only while our limited supply lasts. We suggest that you order one or more copies immediately. Of course, if you are not satisfied after you have had an opportunity to examine it in your home, simply return the book and the Museum will refund the purchase price.

Natural History Books

Gold of El Dorado Book
American Museum of Natural History
77 West 77th Street
New York, N.Y. 10024

YES, I want to purchase _____ copy/copies of the Gold of El Dorado book. I ☐ enclose payment of/☐ authorize you to charge me $6.25 per copy (plus $1.00 for shipping and handling).

My name _____

My address _____

City _____ State _____ Zip _____

For charge orders only:

Charge to: ☐ Master Charge ☐ VISA ☐ American Express ☐ Diners Club

Interbank # (Master Charge Only) _____

Account # (All digits) _____

Expiration Date _____

Signature _____
(required if using credit card)

Order

_____ book(s) @ $6.25 $____

Shipping and handling $1.00

N.Y. Sales Tax (if applicable) ____

TOTAL $____

(Make checks payable to American Museum of Natural History)

Patterns of Paradise

" I [s]hall now describe their method of makeing cloth, which in my opinion is the only curious manufacture they have, all their cloth is I beleive made from the bark of trees, the finest is made from a plan[t] which they cul[t]ivate for no other purpose.... They let this plant grow till it is about six or eight feet high the stem is than about as thick as ones thum or thicker, after this they cut it down and lay it a certain time in water, this makes the bark strip easy off the out side of which is than scraped off with a rough shell, after this is done it looks like long strips of raged linnen. These they lay together, by means of a fine paste made of some sort of a root, to the breadth of a yard more or less and in length Six, Eight or ten yards or more according to the use it is for, after it is thus put together it is beat out to its proper breadth and fineness upon a long square piece of wood with wooden beaters the cloth being kept wet all the time; the beaters are made of hard wood with four square sides and about a foot long including the handle which is round, each of the square sides are about 3 or 4 inches broad and cut into grooves of different fineness this make the Cloth look at first sight as if it was wove with threed.... The finest sort when bleached is very white and coms nearest to fine Cotton. Thick cloth especialy fine is made by pasting two or more thickness's of thin cloth made for that purpose together."

The Journals of Capt. James Cook: The Voyage of the Endeavour *1768–1771*

Wherever James Cook met indigenous tribes on his voyages in the South Seas, he found the "curious manufacture" of bark cloth in use—for clothing, bedding, swaddling, bandaging, burials, and for buying and selling. He collected all kinds of bark cloth products, including magnificent cloaks from Hawaii, rolls of fine white linenlike cloth, effigies and masks, and thick mats decorated with colorful geometric patterns. To the British of Cook's day, the South Pacific was an exotic paradise, inhabited by natives "wearing nothing but the bark of trees." Interest in bark cloth was great enough that some of Cook's specimens were cut up for a catalog—a bark sampler if you will—with the somewhat extended title: "A Catalogue of the Different Specimens of Cloth Collected in the Three Voyages of Captain Cook to the Southern Hemisphere, with a Particular Account of the Manner of the Manufacturing the Same in the Various Islands of the South Seas, Partly Extracted From Mr. Anderson's and Reinhold Forster's Observations, and the Verbal Account of some of the most knowing of the Navigators with Some Anecdotes that Happended to them Among the Natives."

Cook's catalog and 125 other fine specimens of bark cloth (properly called tapa) will be on display in "Patterns of



Painted bark cloth is stretched over a rattan frame in this night-dance mask from Papua New Guinea.

Ron Testa / Field Museum of Natural History

Imported by The Paddington Corporation, New York, N.Y. 34 Proof © 1981



BAILEYS.
THE ORIGINAL IRISH CREAM LIQUEUR.

THE CREAM IS REAL. THE SPIRITS ARE REAL.
ONLY THE TASTE IS MAGIC!

A RARE BEAR.

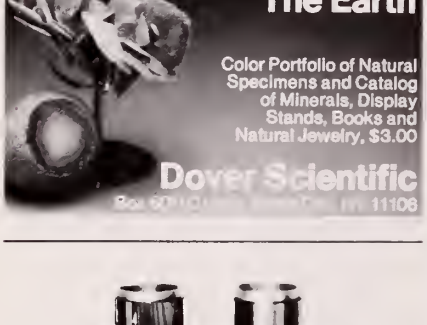
THE GIANT PANDA



The Institute of Zoology of the Chinese Academy of Sciences and Beijing Zoo

An enlightening, beautifully illustrated volume on one of the world's rarest and most fascinating animals — the giant panda. Representing the first recorded observations of the panda in its natural environment, this path-breaking volume features over 150 exquisite full-color photos of the animal at play, nurturing its young, searching for food, and performing daily survival activities. Co-published by Van Nostrand Reinhold and Science Press of the People's Republic of China. *180 pp., 9 x 12, illus., $29.95*

Available at your bookseller or write:
Van Nostrand Reinhold, 135 West 50th Street, New York, N.Y. 10020, Attn: Mary Kortes *N7060*





BUSHNELL 7x35 CUSTOM
Mfg. List $280.00 Postpaid $164.00

This is an example of the deep discount prices on high quality optics that is found in our FREE catalog. This catalog lists and illustrates an outstanding selection of telescopes, binoculars etc., plus valuable information on how to properly select them. Write for it today.

GIL HEBARD OPTICS
COURTHOUSE SQ., KNOXVILLE, ILL. 61448

Crossroads of Evolution

Galapagos

Cruise Darwin's "enchanted island" by private yacht. Photograph unusual wildlife. Enjoy stimulating lectures by naturalist/guides. Visit artistic Cuenca on mainland Ecuador. 15 days. Write for details.

Society Expeditions
Dept. NH-10
723 Broadway East
Seattle, WA 98102

Name

Street

City/State/Zip

Please include: ☐ New Guinea ☐ Galapagos ☐ Mongolia ☐ Tunisia ☐ Antarctica ☐ Amazon ☐ New Guinea & Melanesia ☐ New Guinea & Indonesia ☐ Singapore to Seychelles ☐ Arabia ☐ Iceland & Greenland ☐ N. & West Africa ☐ China

Ron Testa/Field Museum of Natural History



Paradise," a new exhibition opening at the American Museum of Natural History on Wednesday, November 18. The exhibition comes from the Field Museum of Natural History in Chicago, which has one of the best collections of Oceanian art in the United States.

The making of tapa is an ancient craft, and anthropologists think it may date back to 2,000 B.C. or earlier. By 1,000 B.C. tapa making was widespread in Asia and Indonesia, where the material was used for much the same purposes as woven cloth elsewhere. In the eighteenth century, Pacific islanders wearing "nothing but bark" were actually handsomely attired in dresses, robes, blouses, and skirts with intricately painted patterns, often embellished, among the ruling classes, with feathers and other decorations. In Hawaii, skirts, called *pa'u*, were made of as many as ten layers of tapa, each up to six or seven feet long. Kamamalu, the wife of King Kamehameha II, who ruled Hawaii in the first part of the nineteenth century, was said to have worn a ten-layered *pa'u* that was so long and unwieldy that she had to lie down to have it put on. When Cook was killed in the Hawaiian Islands in 1779, his body was buried in the traditional tapa shroud.

There are a number of tropical plants with a pliable inner bark suitable for making cloth, and in most places where these plants grow—Africa, South America, Asia, the Pacific—bark cloth is made. The paper mulberry is the favored plant in the Pacific; the islanders still make tapa in much the same way that Cook described—by stripping off the bark and then removing its outer layer to expose the soft inner skin. Often the bark is soaked before it is beaten. Most tapa beaters have a ribbed or textured surface; beating is done with increasingly finer textured beaters, until finally either a beater with a smooth face or one with a carved pattern to be imprinted on the finished cloth is used. The beating of tapa—women's work—is traditionally a very public and social



Broad bands with sawtooth edges were probably painted freehand on this tapa cloth from the Samoa Islands.

activity, often performed like a symphony with each beater producing a different tone and rhythm. On islands where tapa making is a thing of the past, older women remember the tapa beating of their childhood with nostalgia.

The finished cloth is often dyed, painted, or printed. Each group of Pacific peoples has its characteristic colors and patterns, which range from somewhat realistic renditions of plants and leaves to geometric, repeating designs.

"Patterns of Paradise" was organized by two members of the Field Museum staff—John Terrell, associate curator of Oceanic archeology and ethnology, and Anne Leonard, anthropology researcher. Splendid examples of tapa—among them specimens collected by Cook—are included, as well as stonework, pottery, woodcarvings, tapa tools, and other artifacts from the Pacific islands. The traveling exhibition will remain in Gallery 77 of the American Museum until February 14, 1982.

Douglas J. Preston

SALE! SAVE OVER $12. THOUSANDS OF THESE SUPERB CLOCKS SOLD AT $20.00 NOW ONLY $7.77 SAVE MORE! 2 for only $7.44 ea.

FANTASTIC

Sticks-Up Everywhere Calendar Clock

Displays hour & minutes with quartz crystal accuracy—**changes automatically every 2 seconds to show month & date!**



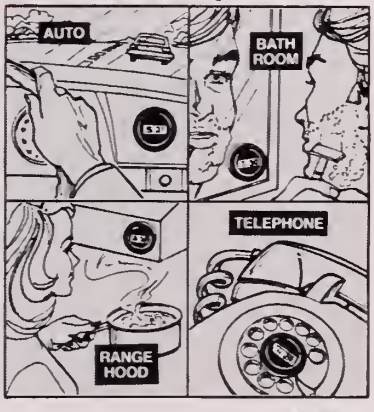
Fantastic Price Break
Not $~~20.00~~ Not $~~14.95~~

NOW ONLY $7.77 SAVE MORE! 2 for only $7.44 ea.

IT'S SO EASY TO "STICK 'EM UP!"

• 1½" DIAMETER • ½" THICK • ½ OUNCE WEIGHT

Use 'em everywhere to keep you on schedule:
•TV set • attache case • refrigerator • desk • boat



- NO WINDING! NO PLUGS! NO BUTTONS TO PUSH!
- SPACE-AGE ACCURACY!
- BUILT-IN COMPUTER adjusts for long and short months!
- EASILY REPLACEABLE BATTERY (included) powers clock for one FULL YEAR!
- *SUPER-STICK, DETACHABLE FELT BACKING grips instantly to any surface, lets you STICK 'EM UP ANYWHERE!*
- CHOOSE FROM 3 DECORATOR COLORS—red, yellow or beige!

Now, at home, in the office, in your workshop or garage, have the TIME AND DATE always just a glance away—with these incredible LCD-DISPLAY CALENDAR CLOCKS!

And now, during this fantastic PRICE BREAK, order extra CALENDAR CLOCKS *AND SAVE EVEN MORE!*

SATISFACTION GUARANTEED or your purchase price refunded.
RUSH YOUR ORDER TODAY!

Adam York/**UNIQUE** Products Co. Hanover, PA 17331

SATISFACTION GUARANTEED—MAIL TODAY

Adam York/UNIQUE Products Co., Dept. UZ-5742, 340 Poplar St., Hanover, PA 17331

☐ **YES!** Please send me one STICK 'EM UP CALENDAR CLOCK #Z5301058 for ONLY $7.77 plus $1.25 postage & handling!
Color choice: _____
☐ **SAVE!** Send me 2 CALENDAR CLOCKS for ONLY $14.88 plus $2.25 postage & handling!
Color choices: _____
☐ **SAVE MORE!** Send me 3 CALENDAR CLOCKS for only $21.88 plus $3.00 shipping & handling!
Color choices: _____
☐ Check or money order enclosed for $_____ (PA residents please add sales tax.)
CHARGE TO: ☐ American Express ☐ VISA ☐ Carte Blanche ☐ Diners Club ☐ MasterCard
Acct. # _____ Exp. Date _____

PRINT NAME _____
ADDRESS _____
CITY _____
STATE _____ ZIP _____

☐ Check here and send 50¢ for year's subscription to our full-color catalog of fine gifts (Z389932X). We ship within 48 hours; delays notified promptly. Delivery guaranteed within 60 days.

© Adam York/UNIQUE Products Co., 1981

SRI LANKA

The island of Serendip in the Indian Ocean better known to you as Sri Lanka or Ceylon offers you the most unexpected discoveries.

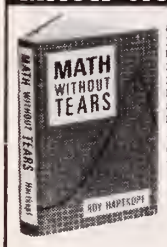
You will see in this resplendent land one of the world's oldest cultures and marvel at its ancient cities, built before Rome was founded.

Optional excursions to the architectural splendors of North & South India and the Himalayan Kingdom of Nepal; the coral formations and tropical atolls of Maldive Islands, wild life parks where you can see leopard, the rare black deer, loris, elephant and various other species of animals and birds; golden unspoiled beaches of Bentota and Trincomalee.

For brochures write to:

JOURNEYWORLD
155 East 55th St., New York, N.Y. 10022
Tel: (212) 752-8308

MATH WITHOUT TEARS



Using non-technical language and a light touch Roy Hartkopf gives you a basic understanding of many everyday applications of mathematics. He takes the reader from simple counting to trigonometry and calculus, emphasizing the practical aspects of math. Humorously written.
Learn math in the comfort of your own home at minimum cost.
Order Now $10.95 plus $1.10 hdlg
EMERSON BOOKS, INC.
Dept 964-F Buchanan, N.Y. 10511
10 Day Money Back Guarantee

TICKLE THE IVORIES!
PATENTED SYSTEM!



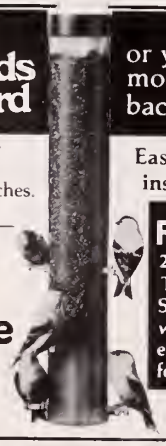
FASTEST, EASIEST PIANO COURSE IN HISTORY!
FREE INFORMATION CORRELATION MUSIC,
BOX 751-A, LA CANADA, CA 91011

More Birds in Your Yard
or your money back!

Thistle Seed Feeder attracts finches, chickadees, nuthatches. Send $11.50 PPD.

Write for FREE Catalog today.

The Bird Tree
5336 East Bald Eagle Blvd., Dept. 84
White Bear Lake, MN 55110



Easy-to-install

Free
2 lb. Thistle Seed with each feeder.

Patterns of Paradise

An exhibition containing more than 150 examples of tapa from the Pacific and Caribbean islands, Southeast Asia, Africa, and South America will open in Gallery 77 of the American Museum on Wednesday, November 18. See article on page 104.

Patterns of Paradise will be free to all Museum visitors.

Dance Première

Hurakan (*Heart of Heaven*), a full-length modern dance piece by the Sundance Company, will have its New York première in the Museum's Auditorium on Sunday, November 1, at 2:00 P.M. The Sundance Company spent two years conducting research on the ancient Maya before the piece began to take its final form. Based on Maya myths and symbolism, *Hurakan* is not a re-creation of ancient dances but an impressionistic dance, created to give the viewer a sense of the Maya culture.

The program is free to all Museum visitors.

Glories from the Sea

On the weekend of November 21 and 22, Education Hall will turn into a veritable paradise for people intrigued and awed by the beauty of shells. For this *Member's Shell Weekend*, samples from the Museum's collection of more than two million specimens, and from the collections of the New York Shell Club, will be on display; scientists from the Museum's Department of Invertebrates will be on hand to discuss mollusks and their life styles; and a Mollusk Film Festival will be screened in the Auditorium. Many more activities are planned for this two-day look at some of the world's most beautiful creatures. The program is free for members, $2.00 for nonmembers. No reservations are necessary.

John Burroughs: Poet-Naturalist

How Far Are We from Home: John Burroughs, a film portrait of the American poet-naturalist, will be shown in the Auditorium on Wednesday, November 18, at 7:00 P.M.

Through his books and articles, Burroughs (1837–1921) probably did more than any other writer to create an interest in the natural sciences and outdoor life. His essays were used as the basis for the first nature studies in American schools.

The program will be free to all Museum visitors.

Ghost Stories

All manner of spooks and spirits will haunt the Museum on Sunday, November 1. Still reveling from Halloween the night before, they will join Laura Simms and other storytellers for sessions of *Ghost Stories from Around the World*. There will be three sessions: at 11:00 A.M. and at 1:30 and 3:30 P.M. The morning session, with slightly friendlier ghosts, is especially geared for children up to age seven. The two afternoon sessions are for all ages. Tickets are $1.00 for members,



Tapa headbands (deep orange) and loincloths from the Solomon Islands derive their color from turmeric.

$2.50 for nonmembers. Reservations are required. For information call (212) 873-1327.

Classical Dances from Cambodia

Only a year ago it was feared that the classical dances of Cambodia had vanished under the Khmer Rouge regime. Nevertheless, for five years, a troupe of artists, musicians, and dancers managed to disguise themselves as farmers before working their way through the Thai refugee camps to get to the United States. This troupe will perform in the Museum Auditorium on Sunday, November 15, at 2:00 P.M. in a program presented in cooperation with the Society for Asian Music.

Training for Khmer dance begins in early childhood when the limbs are supple enough to bend in the characteristic curves of the classical dances. Many of the dancers in this group trained in the Royal Palace Dance School in Phnom Penh and once danced with the Palace troupe.

The program is free to all Museum visitors. For information call (212) 873-1300, ext. 559.

Sky Show

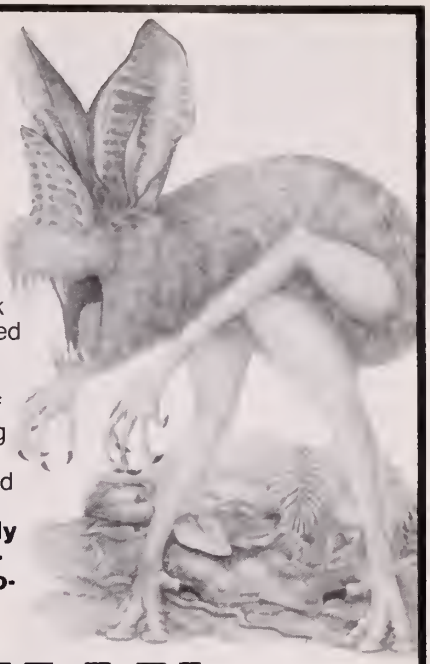
Beginning November 25, the Sky Show at the Hayden Planetarium will be *Star of Wonder*. This show has been delighting New York holiday audiences for more than forty years. It journeys back 2,000 years for a look at the sky of Bethlehem at the time of Jesus' birth. What was the "star of wonder" that led the wise men on their journey? Was it a comet? A bright meteor? Some have suggested that it was a nova or even a rare grouping of the planets. The show will run through January 5, 1982, and is a celebration of the holiday season for one and all. For more information call (212) 873-8828.

To Dance One's Dreams

Myths and stereotypes concerning Native Americans have acted as barriers to cultural communication between Indians and non-Indians. On Sunday, November 8, at 2:00 P.M. in the Auditorium, a new bridge will be explored: communication through movement and dance. Solaris, a modern dance company, will perform in conjunction with dancers from the Lakota Sioux nation. *Ihanbla Waktoglag Wacipi* (*To Dance One's Dreams, Visions, or Exploits*) combines traditional dances performed by the Lakota Sioux with Solaris's interpretations of some of the modern-dance legends and myths.

This free performance will be the New York première of the work. For information call (212) 873-1300, ext. 559.

...and the night stalkers
(manambulus perhorridus)
shall inherit the earth.



AFTER MAN is an astonishing look at the evolution of the future. A noted paleontologist's text, and dramatic full color illustrations, introduce the trevel, the bootie bird and scores of exotic but credible beasts (including the charming little fellow alongside) that will live millions of years beyond man's extinction.

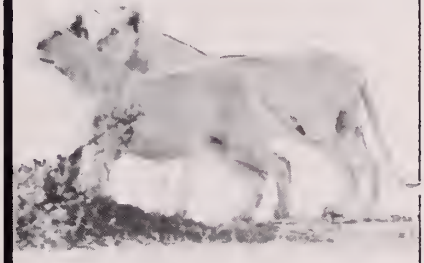
"A marvelous idea, beautifully presented...I wish I had written it myself."—from the Introduction by Desmond Morris

AFTER MAN A Zoology of the Future
by Dougal Dixon

Oversize format, illustrated throughout, $14.95

Visit rare old friends...

The snow-white lion cubs discovered by Chris McBride in 1975 became the subject of news articles, TV appearances, a film, and McBride's book, *The White Lions Of Timbavati*. Now he describes the adult lives of this unique pair, the dangers that threaten their world, and the heroic efforts necessary for their survival. $15.95

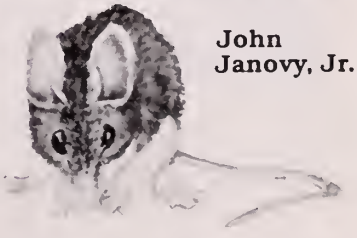


OPERATION WHITE LION
Chris McBride

Take another trip...

The author of *Keith County Journal* continues his elegiac observations of the diverse inhabitants of Keith County, Nebraska, including the tiger beetle, the Rocky Mountain toad, the Lonnie Paul Dinkle. As the *Boston Globe* observed of his earlier work, "This is not simply a book about nature. It is about life." Illustrated, $10.95

BACK IN KEITH COUNTY



John Janovy, Jr.

New from St. Martin's Press

Available at bookstores or direct from the Publisher: 175 Fifth Avenue, New York 10010

Collector's Find!



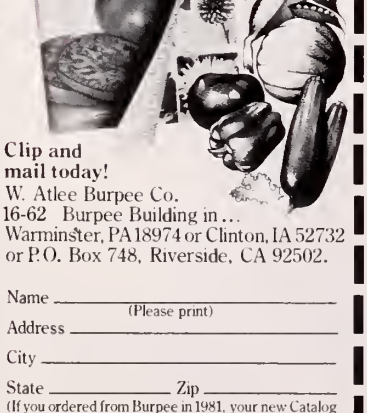
SOLID BRASS UNICORN

The stuff that dreams and songs and legends are made of . . . a magical unicorn, captured in gleaming, solid brass. Magnificently detailed . . . so real, you can almost hear him breathe. This mythical creature, discovered in a long-ago, far-away garden, symbolizes purity and innocence—and good fortune to anyone who catches one. An enchanting objet d'art for display shelf, executive desk, mantel, boudoir . . . Splendid gift for collectors of things bright and beautiful. A majestic 8" tall with protective felt base. *Brass Unicorn* (Z644559) Only $19.99 + $2.00 P&H. 2 for $38.00 + $3.50 P&H. FULLY GUARANTEED. PA Residents add Sales Tax.

PENNSYLVANIA STATION, Dept. PZ-8641
340 Poplar St., Hanover, PA 17331

Send me Burpee's® free 1982 seed catalog!

It's packed with over 400 vegetables and 650 flowers—including new varieties and Burpee exclusives! Plus fruits, shrubs, garden aids, and more! Send for yours *now!*



Clip and mail today!
W. Atlee Burpee Co.
16-62 Burpee Building in...
Warminster, PA 18974 or Clinton, IA 52732
or P.O. Box 748, Riverside, CA 92502.

Name _____ (Please print)
Address _____
City _____
State _____ Zip _____
(If you ordered from Burpee in 1981, your new Catalog will be sent to you automatically.)

Following the Caribou

by John P. Kelsall

CARIBOU AND THE BARREN-LANDS, by George Calef. *Canadian Arctic Resources Committee*, 46 Elgin Street, Ottawa, Ontario K1P 5K6, *$34.95; 176 pages, illus.*

An old Chipewyan Indian proverb says that "no one knows the ways of the wind and the caribou." While this is still partly true, George Calef in his beautiful new book *Caribou and the Barren-lands* shows how far knowledge of this once mysterious animal has advanced.

The caribou of northern North America have interested succeeding generations of explorers, traders, missionaries, settlers, and scientists since the sixteenth century. It is fair to say that a good deal of human endeavor, and simple subsistence, could not have been maintained had it not been for the ubiquitous caribou and for the meat and hides that they provided. Settlements and seasonal camps were strategically placed so that once or twice a year an abundance of caribou would migrate by and provide the hunters with the necessities of life. When the caribou did not come, and that sometimes occurred, hardship or starvation resulted.

The migration and numbers of the caribou were a mystery to man until the twentieth century. The realization that the same caribou that were hunted on the arctic coast in summer by Inuit (Eskimos) were also hunted in the forest in winter by Indians was slow to become generally accepted. Despite great reductions in the numbers of the animals on the peripheries of their ranges, some instances being recorded near the turn of the eighteenth century by Samuel Hearne and Sir John Franklin, most people believed that there were vast untapped herds in the uninhabited centers of their ranges. As late as 1930, George Critchell-Bullock wrote that the caribou as a whole were safe because "all but the flankers of the annual movements [are] immune from systematic slaughter." In the early twentieth century Ernest Thompson Seton estimated that the Canadian Barren Lands held 30 million caribou "with the wind blowing through their whiskers." That figure haunted successive generations of caribou biologists who knew that the ranges involved were unlikely to have held one-tenth that many animals.

Much of the mystery of caribou movement and numbers began to disappear when biologists were able to survey and census from the air. Development and use of bush aircraft, on skiis in winter and floats in summer, made all the caribou ranges safely and quickly accessible by the 1930s. *Caribou and the Barren-lands* draws primarily on knowledge gained during the past thirty years by scientists using air transport.

Profusely illustrated with the author's own superb photographs, the book must not be relegated to the "coffee table" category. Sponsored by the Canadian Arctic Resources Committee, Calef's book makes a strong plea for the conservation of the caribou while providing exhaustive information about the life cycle, ecology, and management of this remarkable animal.

Part I is devoted to a year in the life of the caribou, and describes in great detail

the cycle of migration and all associated phenomena: the spring migration; the attainment of the far northern calving grounds and the birth of a new generation; the formation of great aggregations of insect-tormented animals in summer; the rutting period and a traditional annual hunt by Indians; and finally, the vicissitudes of the often harsh and hazardous northern winter.

Caribou and the Barren-lands deals with North American caribou, and particularly with three herds that traditionally make great annual migrations from winter ranges in the northern coniferous forests to calving grounds and summer ranges far north on the tundra. For his descriptive narrative of spring migration and calving, the author chose the Bathurst herd of the central Canadian mainland as a subject. For his study of caribou in winter, Calef uses the Beverly herd, the next great herd to the east. While they are neighbors, sometimes even exchanging animals, those two herds are considered discrete because they consistently use separate and distant calving grounds—Bathurst Inlet on the arctic coast and Beverly Lake in the central tundra, respectively.

Having spent much of my time from 1949 to 1959 following one or the other of those herds by foot, dog team, canoe, and aircraft, I can honestly say that reading Calef's narrative was rather like going home after a long trip. Beautifully done! Where I disagreed with the text, it was usually on interpretation rather than observation. It would, after all, be a strange pair of field biologists who saw everything in the same light.



Detail from Age of Reptiles

Dinosaurs and Mammals from Yale

The original 110-foot "Age of Reptiles" mural in the Great Hall of the Peabody Museum took four and a half years to complete and won the artist, Rudolph F. Zallinger, a Pulitzer Prize. The mural depicts thirty dinosaurs in six successive eras of earth history. The 60-foot "Age of Mammals" mural presents the fauna and flora of the Paleocene to the Pleistocene era. Beautiful full-color reproductions of these unique masterpieces are available in two sizes. The larger, deluxe format—over 9 feet long—is a lithographic print on a heavy, durable paper. The smaller version (6 feet long) is printed on glossy paper. Illustrated guidebooks are available for each mural.

To order your copies of these beautiful reproductions, fill in the coupon below and send with your payment to:

Yale Peabody Museum Associates
Department NH81, 170 Whitney Ave.,
P.O. Box 6666, New Haven, Connecticut 06511

Make checks payable to Yale University. Postage is included in price listed below.

		Dinosaurs	Mammals
Deluxe reproduction	$33.00 (USA)	_____copies	_____copies
	$40.00 (Foreign airmail)	_____copies	_____copies
Poster	$ 5.00 (USA) $5.50 (Foreign)	_____copies	_____copies
Guidebook	$ 3.00 (USA) $3.50 (Foreign)	_____copies	_____copies

Name _____

Address _____



If you'd like a wall poster of our distillery's founder, drop us a line

MR. CLAYTON TOSH has more good tales about Jack Daniel than most folks can ever believe.



He'll tell you that Mr. Jack promised marriage to two girls at once in 1875; that nobody ever saw him without a coat and tie; and that he perfected a way of manufacturing his whiskey (called charcoal mellowing) that made it uncommonly smooth. Of course, there's no one living who can vouch for the first two tales. But after a sip of Jack Daniel's, most everyone goes along with the third.



CHARCOAL MELLOWED DROP BY DROP

Tennessee Whiskey • 90 Proof • Distilled and Bottled by Jack Daniel Distillery
Lem Motlow, Prop., Inc., Route 1, Lynchburg (Pop. 361), Tennessee 37352

Placed in the National Register of Historic Places by the United States Government.

For the narrative of summer and autumn activities, the author turns westward to the Porcupine herd (named for the Porcupine River). That herd, still numbering about 100,000 animals, ranges impartially back and forth across the international boundary between Alaska and the Yukon Territory. The herd tends to calve in the United States and winter in Canada, crossing the border several times each year. When the caribou cross the Porcupine River in autumn and spring, they are subject to a traditional Indian hunt, which Calef describes graphically.

For the sake of continuity, it might have been easier for the author, as well as the reader, if a single caribou herd had been chosen and followed throughout the year. Perhaps the author wished to show, through contrast between the herds and their habitat, how caribou have adapted to diverse biological and geographical conditions.

An innovative technique is used to present each chapter in part I of the book. First, an accurate and entertaining narrative, designed perhaps for the lay reader, follows the caribou through a particular part of their annual cycle. Each narrative is followed by a more scientific account of the events of the same period. Additional details are given of the seasonal biology and ecology, as well as current thought in the dynamic and argumentative field of caribou—and predator—management. This dual approach comes off well in my view, despite some lingering doubts as to why it was done. Redundancy, which could become a great problem in using such a technique, has been avoided by the author.

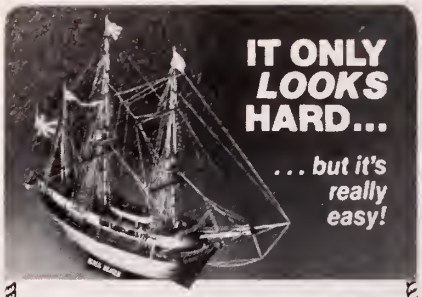
Part II, the shorter part of the book, describes the dependence of man on the caribou as a source of meat, hides, bone, antler, and perhaps spiritual well-being, from prehistoric times to the present. The thorny problems of management are described. While the author makes his feelings on some aspects of management clear in earlier text, it is here that he puts them all together.

George Calef has studied caribou for a decade and, in that time, he has observed at all seasons the herds that he has described. Beyond his personal experience with caribou, he is an expert synthesizer of information taken from many sources. He is also an accomplished photographer. His 118 pictures, in color, depict not only the caribou but also a wide array of the fauna, flora, and the biogeography of the country. Adequate maps have been provided so that



Photographs by George Calef





IT ONLY *LOOKS* HARD...

... but it's really easy!

The secret's in our kits—imported from Europe—where these historic ship models are hand-crafted in walnut and rich woods by some of the finest model makers in the world. Solid brass, cast bronze and detailed wood fittings are used throughout. The hard work is done for you—most parts are *pre-cut*. Assembly is simple as you follow step-by-step instructions and large scale plans. Everything you need to complete is included, and we guarantee satisfaction.

Even if you have never built a ship before send for our full-color catalog. See how easy it can be to build a museum quality model you will display with pride in home or office. Only $2.00



Mail This Coupon Today!

MODEL EXPO, INC.
23 Just Road, Fairfield, N.J. 07006 Dept. NH-111

Please send full-color catalog $2.00 enclosed

Name _____

Address _____

City _____ State _____ Zip _____

For the naturalist's library...



a book destined to become *the* standard reference in its field. Illustrated with over 180 photos by the author, who is the most published wildlife photographer in North America.

FURBEARING ANIMALS OF NORTH AMERICA

by LEONARD LEE RUE III,
author of *The Deer of North America*

A Crown/Herbert Michelman Book.
$19.95, now at your bookstore, or use coupon to order.

CROWN PUBLISHERS, Dept 604
34 Engelhard Ave., Avenel, N.J. 07001
Please send me FURBEARING ANIMALS OF NORTH AMERICA. Enclosed is my check or money order for $19.95 plus $1.70 postage and handling charge. If I wish, I may return book postpaid within 10 days for full refund.

Name _____

Address _____

City _____ State _____ Zip _____

CROWN



the reader can follow the text and the caribou.

Sponsored by the Canadian Arctic Resources Committee, *Caribou and the Barren-lands* is a credit to both author and publisher. For those interested primarily in fine photography of arctic wildlife, this book provides a feast. While biologists may pick a few nits here and there over minor discrepancies, the narrative is a pleasure to read. The committee's purpose, to contribute to public understanding of a major renewable resource, has been well served.

The real debate over *Caribou and the Barren-lands* will be between people who have been following recent technical arguments over the place of the wolf in the world of the caribou. Calef supports those who say that wolves, and men equipped with the most modern hunting technology, provide simply too much predation for caribou herds to stand. In fact, some argue that wolves alone can cause a caribou herd to decline. Others take the view that since wolves and caribou have evolved and lived together for countless millenniums, wolf control is only necessary in particular places and cases. There has been much spirited debate on this at technical conferences in recent years. George Calef's view is a legitimate one to put forward for consideration, and it deserves a hearing. For my money, however, the jury is still out.

John Kelsall was until recently a senior research scientist with the Canadian Wildlife Service. He is the author of numerous technical and popular articles, including an award-winning book on Canadian caribou.







Cut and Dried

Preserving meat by drying it is a simple, prehistoric process

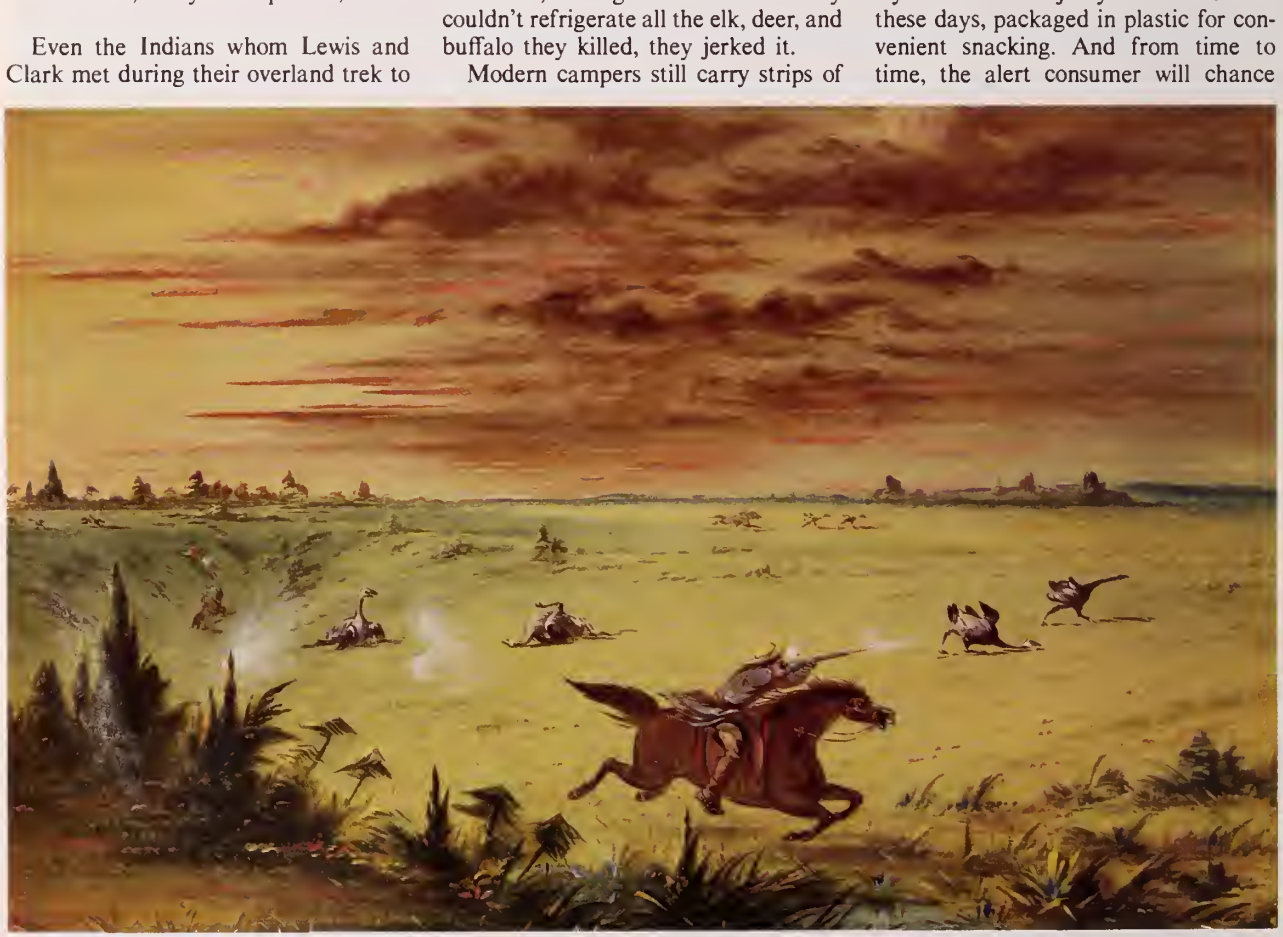
by Raymond Sokolov

After going 12 miles we were fortunate enough to find a few willows, which enabled us to cook a dinner of jerked elk and the remainder of the dogs purchased yesterday.

The History of the Lewis and Clark Expedition,
by Meriwether Lewis and William Clark, entry for April 26, 1806.

Even the Indians whom Lewis and Clark met during their overland trek to the Pacific Northwest thought it disgusting that white explorers would eat dog meat. But fresh meat was sometimes desperately scarce, especially to the west of the Continental Divide, and the Indian taboo against eating dog left many a cur for less fastidious visitors. Lewis and Clark's other mainstay was, of course, shot game. But since they couldn't refrigerate all the elk, deer, and buffalo they killed, they jerked it.

Modern campers still carry strips of beef jerky with them on the trail. It is a light, compact source of protein with a long "shelf life," and it is tasty. I had some in my pack this summer and enjoyed chewing it on the way up Tuckerman's Ravine, the sheer glacial gouge that runs up to the summit cone of Mount Washington. Almost any country store sells beef jerky over the counter these days, packaged in plastic for convenient snacking. And from time to time, the alert consumer will chance



Painting of rhea hunt by George Catlin. From the Mellon Collection, National Gallery of Art, Washington, D.C.

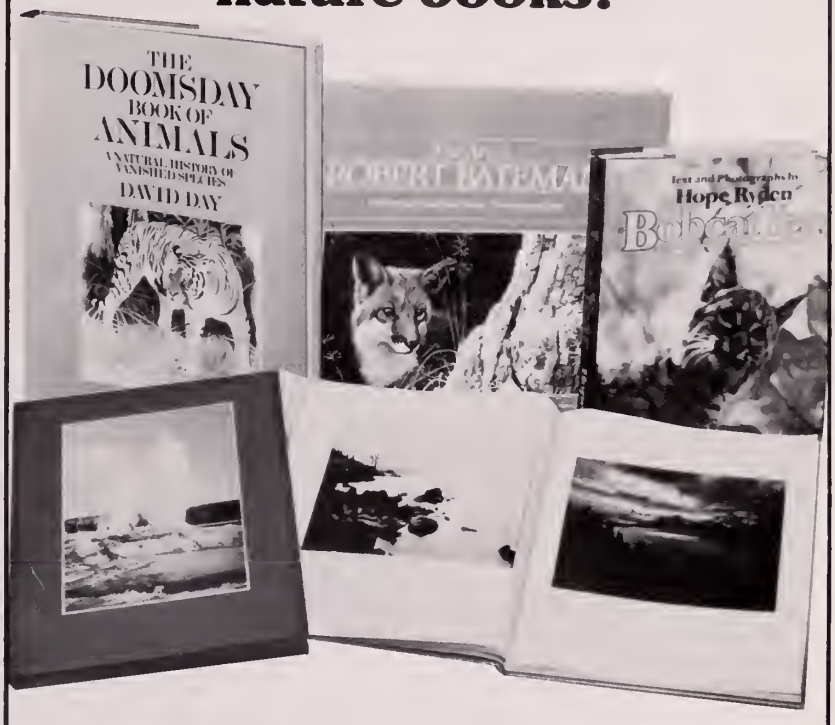
upon roadside jerky producers who sell this vestige of frontier days in larger quantities. A couple in eastern Maine, who were principally engaged in commercial smoking in their backyard, had a sideline in jerky when I stopped in a year ago. So did a butcher shop in Bay City, Oregon, on the Pacific Coast.

Despite these widely scattered signs of persisting interest in jerky, it is safe to say that this prehistoric method of meat preservation has virtually dropped from view in the United States and that no serious jerky revival is about to engulf us as the next chic food fad following upon the heels of the quiche.

Indeed, I will wager that few Americans can explain what jerky is. The answer is as simple as the process. Jerky is any meat that has been preserved by drying. Most jerked meat is cured in salt, first of all, and then set out to dry, but salting is not strictly necessary. The important thing is to cut the meat in thin strips and then expose them to the air. Some people pin the strips to a clothes line. Others set them outside on racks and protect them from insects with screens. Thick pieces of meat dry more slowly and run a greater risk of spoiling.

The resultant meat not only keeps well, but has a mild flavor and an appealingly chewy texture. The Swiss have perfected jerking to its highest level, using the cool, dry air of the Alps to create that sublime form of beef called Bündnerfleisch and a jerked ham named Bündnerschinken. "Bündner" comes from the Swiss-German name for the mountainous canton of Graubünden. Because the thin air thereabouts is dependably low in temperature, whole pieces of meat can be dried without fear of spoilage and without heavy salting.

The season's most beautiful nature books!



AMERICAN PHOTOGRAPHERS AND THE NATIONAL PARKS
Published in collaboration with the National Park Foundation
The 37 most famous 19th- and 20th-century photographers capture the glory of our richest natural resource. 11" x 12⅝", 24 full-color, 287 duotone photos, slipcased. With essays by Robert Cahn and Robert Glenn Ketchum. A STUDIO BOOK

THE ART OF ROBERT BATEMAN
Text by Ramsay Derry
Introduction by Roger Tory Peterson
The first book devoted to the work of one of the world's foremost painters of birds and wildlife. 11⅞" x 11", 82 full-color plates, 40 two-color illustrations, and 13 black-and-white photos. A STUDIO BOOK

BOBCAT YEAR
by Hope Ryden
A **"charming, utterly engrossing"** (*Philadelphia Inquirer*) account of one bobcat's first precarious year, as excerpted in *Smithsonian*. 6½" x 9", 115 photos.

THE DOOMSDAY BOOK OF ANIMALS
by David Day
Foreword by H.R.H. the Duke of Edinburgh
72 full-color and 50 black-and-white illustrations depict over 300 extinct species of mammals, birds, reptiles, and fish. 6½" x 9". A STUDIO BOOK

THE VIKING PRESS, Dept. ATE-NH, 625 Madison Ave., New York 10022
Send me the following:
___ copies of AMERICAN PHOTOGRAPHERS AND THE NATIONAL PARKS @ $75.00
___ copies of THE ART OF ROBERT BATEMAN @ $40.00
___ copies of BOBCAT YEAR @ $15.95
___ copies of THE DOOMSDAY BOOK OF ANIMALS @ $40.00
Include sales tax where applicable plus $2.00 per book for shipping.
I enclose $_____ total.

Name _____
Address _____
City _____ State _____ Zip _____

And when Bündnerfleisch and schinken are sliced paper thin, they resemble a fine prosciutto of extreme mildness. Northern Italians serve the same delicacy under the name bresaola.

In the Americas, where the jerking of meat antedates Columbus, Indians cut the flesh of various game animals very thin so that they could dry it in the heat of the sun. Hopis still jerk mutton, beef, venison, and rabbit. In our day, some cooks in Hopiland practice oven jerking. They marinate meat that has been cut across the grain in ⅛-inch slices, then put it on a rack set in a pan and bake it in a 150-degree oven for six hours with the door ajar. The meat has to be turned every two hours. It turns leathery dry and can be eaten as is. Hopis also cook jerky in some fairly elaborate recipes—roasted and served with chili and tortillas, in tamales, in hash or stews, boiled in bite-sized pieces and mixed into drop dumplings, or boiled until tender and then pounded to shreds, or chopped in a blender and combined with cornmeal gravy.

Plains Indians jerked buffalo before the great herds were destroyed forever by white hunters. Lewis and Clark also jerked buffalo meat when they could get it, and reported that it kept much longer than jerked elk. By the late nineteenth century, when the buffalo were gone, the federal government supplied Indians with beef as a substitute, and they dried it in the ancestral manner of their cultures.

Sometimes Indians used jerky as the main ingredient of pemmican (from a Cree word whose root means fat), an almost imperishable concoction consisting essentially of chipped jerky mixed with melted fat, usually stored in a hide sack. Arctic explorers packed pemmican on their expeditions. They would order it by the ton from north country outfitters, who dressed the stuff up with fruit or raisins and sugar. Even so, pemmican seems to have nauseated explorers and possibly contributed to the deaths of some of those who ate a steady diet of it for months on end and, according to one survivor, succumbed to protein poisoning.

In early America, especially in the isolated homesteads of the plains and prairies, slightly more settled folk dried meat in large batches. Louise K. Nickey, in *Cookery of the Prairie Homesteader*, recalls that when she was growing up on a farm in northeastern Montana before World War I, her mother would dice a cup of dried beef, simmer it in two cups of water for nearly an hour and then serve it in a skilletful of milk gravy, along with buttermilk biscuits.

When I was growing up, one occasionally encountered a survival of this dish, made from a commercial dried beef called chipped beef. Old-fashioned cookbooks often feature recipes for such things as creamed chipped beef on toast. And modern supermarkets still sell chipped beef, which now tends to be smoked, rather than air-dried, and typically comes in jars. But to my mind, chipped beef still counts as a survival from pioneer days, when midwestern and western settlers fried jerky in little shreds until it began to curl at the edges. The technical term for this is "frizzling." Once cooked in this way, or reconstituted through boiling, the beef could be combined with a whole range of foods, mostly starch or vegetables, to give them a protein boost and a crunchy, salty taste.

All through this hemisphere, cooks have done much the same thing with beef jerky. In Brazil, for instance, jerky shreds are mixed with toasted manioc or cornmeal (see recipe). And the national dish of Brazil, that black bean feast called feijoada, canonically includes jerky (*xarque* or *carne seca* in Portuguese) along with various smoked meats and pork oddments.

Jerky is native to Latin America. The word itself derives from *charqui*, the Quechua name for air-dried meat. One imagines that Spanish explorers discovered it when they conquered the Quechua-speaking Incas of the Andes, adopted the word (which is still current in Spanish), and exported the process to the American Southwest.

To this day, in Latin America, people jerk most available meats, not only beef and pork but also the rhea, an ostrich-like bird of the Argentine pampas, and the guanaco, a cameloid relative of the llama, whose flesh is said to resemble veal in taste. Guanaco is particularly prized in the extreme south of South America, where, reportedly, the meat of tough older animals is considered especially desirable when jerked and permitted to go slightly rancid.

In the West Indies, jerked beef also has an honorable history. The French colonizers called it *boucan*, the source of our word *buccaneer*, presumably because the pirates of the Antilles found jerked beef a convenience food in their fast-moving, homeless way of life. In official French, the original Quechua word survives as *charquer*, "to air dry meat." Probably it came into the French language as a result of New World contact between Spanish and French colonists.

It appears, then, that throughout the Western Hemisphere in the age of exploration, jerky was a meat that everyone ate. It was the most primitive and therefore the most appropriate form of cured meat. Today, when we continue to eat more technologically sophisticated preserved meats—corned beef, pastrami, and smoked ham—because we like their taste, we should probably pay just as much attention to jerky, the typical meat of the frontier and an estimable alternative, even in the computer age, to a hamburger.

Raymond Sokolov's new book, Fading Feasts *(Farrar Straus and Giroux), is a collection of food columns that first appeared in* Natural History.

Paçoca de Carne Seca

(Adapted from *Brazilian Cookery, Traditional and Modern*, by Margarette de Andrade)

- 1 pound jerked beef
- 2 tablespoons bacon fat
- 1 tablespoon butter
- 1 grated onion
- Salt
- Malagueta pepper (or cayenne)
- 1½ cups toasted manioc meal or cornmeal

1. Cut meat in pieces, trim off excess fat, and wash well. Soak overnight in cold water.
2. Next morning, hold under running cold water, then dry.
3. Heat bacon fat and butter in a heavy skillet. Sauté onion until it begins to brown. Then add meat pieces and cook over low heat. Stir with a fork, adding a few drops of boiling water from time to time as liquid evaporates. When the meat is brown and tender and almost dry, add salt and chopped malagueta pepper (or cayenne) to taste. Turn into a mortar and pound the meat to fine shreds or chop in blender.
4. Add the manioc or cornmeal a little at a time, until the mixture is the consistency of bread crumbs. Serve immediately.

Yield: 4–6 servings

WE'RE EXXON

We're Bob Payne, turning solid coal into a new source of liquid fuel for America.



America has more energy in coal than the Middle East has in oil. For many uses, however, the coal must be turned into a liquid. Bob Payne is using his 30 years of experience in petroleum refining to do something about that. He manages a test plant that's finding better ways to turn American coal into liquid products we can use in industry, homes and transportation.

The test program will cost $350 million. In addition to Exxon, it's funded by the U.S. Department of Energy, the Electric Power Research Institute, two other U.S. oil companies and companies from Japan, Germany and Italy.

The test plant uses the Exxon Donor Solvent Process which works on many different kinds of coal. It turns 250 tons of coal a day into a liquid that's a substitute for products made from natural crude oil.

Bob Payne and the scores of Exxon people at the test plant know their work is important, because coal is an alternative to foreign oil. It's one more way to produce energy in America, for America.

We're more than 100,000 people working on energy.

EXXON


12 YEARS OLD WORLDWIDE • BLENDED SCOTCH WHISKY • 86 PROOF • GENERAL WINE & SPIRITS CO NEW YORK NY
CHIVAS REGAL
FOUNDED 1801
12
Why settle for champagne?

NATURAL HISTORY

$2

5,06(74.7)M1 (Ref)



12/81


THE ART OF ILLUMINA~ TION.
PROBABLY THE BEST investment you'll ever make in decorating your home. It's the same handmade Waterford crystal that now hangs in such famous places as Westminster Abbey and Kennedy Center. Not only does it illuminate your home, a Waterford lamp or chandelier transforms it.
WATERFORD®
photo Pesaro

NATURAL HISTORY

Vol. 90, No. 12, December 1981

American Museum of Natural History
Robert G. Goelet, President
Thomas D. Nicholson, Director

2 Authors

7 This View of Life *Stephen Jay Gould*
Agassiz in the Galápagos

16 Early Bird Photographers *Worth Mathewson and Margaret Thompson Mathewson*
Mosquitoes, fleas, and perilous heights failed to daunt two boyhood friends at the start of a career in conservation.

24 Sky Reporter *Stephen P. Maran*
Stellar Togetherness

30 Whales at Table *Text and photographs by James W. Greenough*
For a herring dinner, humpback whales perform awesome acrobatics.

36 Seduction on the Wing *John Alcock*
A successful sexual strategy, for some male wasps, at least, is to treat the female to a good meal.

42 Protean Beauty *Illustrations and text by Willard K. Martin*
A family of plants disperses its seeds in diverse and beautiful ways.

50 Survival in Space *Bruce Webbon*
The smallest spacecraft is a carefully engineered suit.

58 Yellowstone Buffalo Winter *Photographs by Jeff Foott*
Three feet of snow pose grave problems for a hungry grazer.

62 Llama Caravans of the Andes *Terry L. West*
A 4,000-year-old system of transport and trade is disappearing.

74 At the American Museum
Meshie Mungkut

80 Celestial Events *Thomas D. Nicholson*

82 Books in Review *Matt Cartmill*
Striger, Striger, Burning Dim

90 Additional Reading

92 A Matter of Taste *Raymond Sokolov*
Endangered Pisces

Cover: *Edward H. White II, first American astronaut to "walk" in space, spent twenty minutes outside the Gemini space capsule in 1965. Photograph from NASA. Story on page 50.*

Alan Ternes, Editor
Judith Friedman, Managing Editor
Thomas Page, Designer
Board of Editors: Carol Breslin, Sally Lindsay, Frederick Hartmann, Vittorio Maestro, Rebecca B. Finnell
Florence G. Edelstein, Copy Chief
Rita Campon, Copy Editor
E. Kay Danzig, Art Asst.
Kay Zakariasen, Picture Editor
Lauren Krenzel, Photo Research
Douglas J. Preston, Publications Editor
Annie R.C. Finch, Editorial Asst.
Lillian Berger
Editorial Advisers: Malcolm Arth, James W. Atz, Niles Eldredge, Kenneth L. Franklin, E.Craig Morris, Norman Newell, Thomas D. Nicholson, Martin Prinz, Gerard Piel, Nina Root

David D. Ryus, Publisher
Bradford D. Smith, Business Manager
Frederick E. Grossman, Production Mgr.
Debra Buck McCord, Asst. Production Mgr.
Ernestine Weindorf, Administrative Asst.
Elaine M. Callender, Advtg. Production Mgr.

Cary Castle, Circulation Manager
Ramón E. Alvarez, Asst. Circulation Mgr.

Natural History *(ISSN 0028-0712), incorporating Nature Magazine, is published monthly by the American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024. Subscriptions: $15.00 a year. In Canada and all other countries: $18.00 a year. Second-class postage paid at New York, N.Y. and at additional offices.*

Copyright © 1981 by American Museum of Natural History. All rights reserved. No part of this periodical may be reproduced without written consent of Natural History. *The opinions expressed by authors do not necessarily reflect the policy of the American Museum.* Natural History *is indexed in* Reader's Guide to Periodical Literature.

Advertising Offices:
Natural History Sales
488 Madison Avenue
New York, N.Y. 10022
President of Sales, Arthur Hill Diedrick
Advertising Manager, Katherine José

Telephone Numbers:
Advertising Sales (212) 826-9467
Museum Information (212) 873-4225
Subscription Orders (800) 247-5470
(800) 532-1272 (in Iowa)

Change of address notices, undeliverable copies, orders for subscriptions, and other mail items are to be sent to
Natural History Membership Services
Box 4300
Bergenfield, New Jersey 07621

Authors

A clinical psychologist in private practice, a free-lance writer and photographer, a charter-boat operator, and a commercial fisherman, **James W. Greenough** may best be described as an inveterate whale watcher. The waters off the coast of southeastern Alaska provide him with ample opportunities to pursue the last activity. His professional research is on high-risk human health behaviors in Alaska. When not engaged with that project, he gardens, not too successfully, in the back of his home in Juneau.





An architect with the firm of Martin/Soderstrom/Matteson in Portland, Oregon, for twenty years, **Willard K. Martin** has been a student and practitioner of the art of watercolor for even longer—thirty years. Curiosity about plants, especially seed pod forms and dispersal mechanisms, combined with a love of travel, has taken him to "many parts of the world to search for and record unusual varieties of seed dispersal methods." Selections of Martin's paintings appeared in the April 1978 issue of *Natural History* ("Seeds in Flight") and in the June–July 1973 issue ("Seeds: Carriers of Life").

During a recent sabbatical, **John Alcock** hied himself to Australia to investigate a group of wasps he had read about. In Wyperfeld National Park, he met up with his quarry: thynnine wasps. The male wasps feed their mates before, during, and after copulation; feeding varies by species. Alcock determined to find out why they do so, rather than copulate and run as so many other male insects do. An associate professor of zoology at Arizona State University, Alcock's research has been on insect reproductive behavior, with a primary interest in the evolution of diversity in insect mating systems. His major diversion is a backyard garden in which, he claims, he grows an unrivaled crop of swiss chard.



THE TASTE BEYOND 12-YEAR-OLD SCOTCH



Discover more.

Let your mature taste lead you from the finest premium Scotch on up to the most expensive 12-year-old Scotch in the world. The Glenlivet. The ultimate in Scotch.

Most premium Scotch is blended and depends on several whiskies for taste and smoothness.

Yet the unblended character of The Glenlivet is noble enough to stand alone. In this distinctive Scotch whisky you'll experience an exceptional smoothness and full-bodied richness, unmatched in all other premium Scotch.

Try the taste beyond premium Scotch.

The Glenlivet
Unchanged since 1824.

Natural Selections

The Whale Called Killer
Erich Hoyt
An enchanting book for anyone interested in animal behavior, and indispensable for anyone interested in whales. "The only book I have ever read that treats this glamorous sea predator in depth."
—ROGER TORY PETERSON.
Illustrated, $17.50



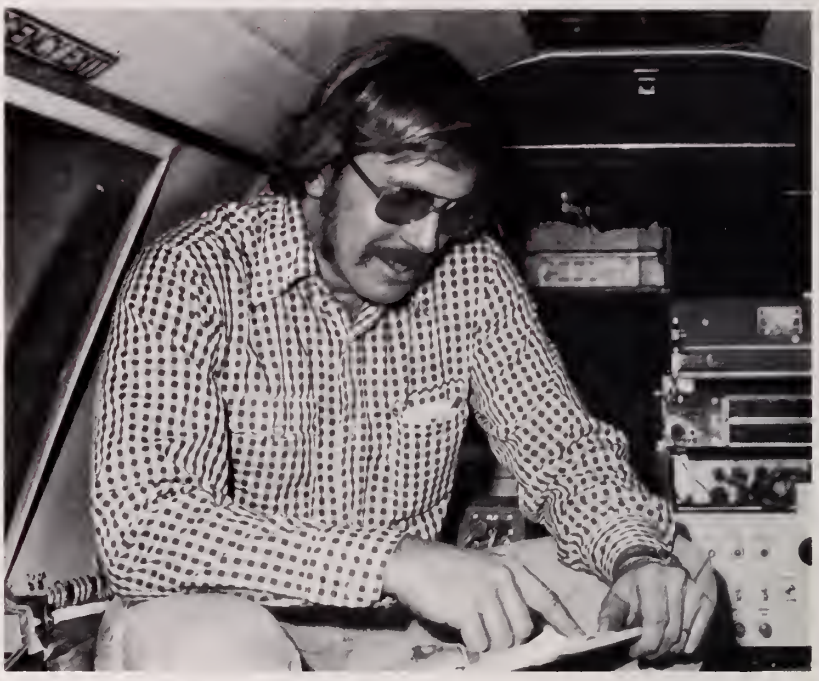
Sea Guide to
Whales of the World
Lyall Watson
Illustrations by Tom Ritchie
The author of *Supernature* presents a natural history of the species from their evolution and classification to their intelligence and sexual habits; the most complete guide in its field to all whales, dolphins and porpoises. Color throughout.
$31.00 ($36.25 after 1/1/82)



The Fall of the Wild, the Rise of the Zoo
Robert Bendiner
"A thorough examination of endangered animals and the importance of zoos...a convincing case for their retention and improvement." —*ALA Booklist*
"An important book."
—*Audubon*
Illustrated, $15.50

DUTTON 2 Park Ave., N.Y. N.Y. 10016

Bruce Webbon is a mechanical engineer who has worked as a research scientist at NASA's Ames Research Center in California for the past six and a half years. Prior to that he was on the staff of the Manned Spacecraft Center (now the Johnson Space Center) in Houston, where he was involved in the Apollo program. Webbon's specialty is the development of advanced spacesuits and life-support systems. He frequently tries on spacesuits himself.



Terry L. West first encountered llama caravans in 1970, when he was a Peace Corps volunteer in Bolivia. Several years later, he participated in one such caravan himself, while researching his Ph.D. dissertation in cultural anthropology. West recently received his degree from the New School for Social Research and is currently working as an archeologist for the Siskiyou National Forest in southwestern Oregon. Married to a Peruvian whose mother is a *curandera* ("folk doctor") in Lima, West would like in the future to conduct research on urban folk medicine.



THE GREAT WALL BY DAY. THE GOOD LIFE BY NIGHT.

The People's Republic of China.

It's the world's most exciting new travel adventure. And starting in May, 1982, you can visit it aboard a remarkable new Cruiseliner.

The "Pearl of Scandinavia."

You'll discover the legendary sights of a magnificent civilization. The Imperial Palaces of the Forbidden City. The Tombs of the Ming Emperors. And most spectacular of all, The Great Wall.

Then, when each shore adventure is behind you, you'll return to a ship that's as comfortable as



home. And as elegant as a European resort.

The China Explorers Cruise is only one of six Asian itineraries offered by Pearl Cruises. One sets sail every two weeks, and includes such exotic destinations as Hong Kong, Amoy, Shanghai, Qingdao, Hsingang, and Dalien.

You can join us for as little as 14 days. Or as long as 42. Just ask your Travel Agent for our brochure or send us this coupon.

And we'll show you all the wonders of Asia. Scandinavian style.



NAK

PEARL CRUISES OF SCANDINAVIA
1045 Sansome Street, San Francisco, CA 94111
(415) 391-7941 (800) 792-0944 in California,
(800) 227-5666 Continental U.S.A.

Send me your full cruise brochure, deck plans and fares.

NAME

ADDRESS

CITY STATE ZIP

MY TRAVEL AGENCY

Registry: Bahamas

Pearl Cruises
of Scandinavia

THE RCA COLORTRAK 2000. TELEVISION ISN'T ALWAYS A MEDIUM FOR THE MASSES.



Most people are willing to settle for less than a top drawer television.

But if you've ever wondered what a true high-performance color TV would be like—and thought that you might appreciate one—you should see the new ColorTrak 2000 series from RCA.

Its color picture is quite simply the best we've ever made. So sharp, so lifelike, that even by ColorTrak standards, it's exceptional.

The Dual Dimension sound system* adds a new dimension of enjoyment—with two separate speakers and a genuine high-fidelity amplifier.

And all that performance comes beautifully packaged in a variety of models. With 57-channel cable capacity and a 17-function remote control.*

If you've been waiting for real high-performance in a color TV, you can see it now at your RCA dealer's. The ColorTrak 2000 series is here.

RCA

We'll Open Your Eyes.

*Available on some models
Simulated TV picture

Agassiz in the Galápagos

Why did the last great scientist-creationist retrace Darwin's footsteps?

by Stephen Jay Gould

I once had a gutsy English teacher who used a drugstore paperback called *Word Power Made Easy* instead of the insipid fare officially available. It contained some nifty words, and she would call upon us in turn for definitions. I will never forget the spectacle of five kids in a row denying that they knew what "nymphomania" meant—the single word, one may be confident, that everyone had learned with avidity. Sixth in line was the class innocent; she blushed and then gave a straightforward, accurate definition in her sweet, level voice. Bless her for all of us and our cowardly discomfort; I trust that all has gone well for her since last we met on graduation day.

Nymphomania titillated me to my pubescent core, but two paired words from the same lesson—anachronism and incongruity—interested me more for the eerie feeling they inspired. Nothing elicits a greater mixture of fascination and distress in me than objects or people that seem to be in the wrong time or place. The *little* things that offend a sense of order are the most disturbing. Thus, I was stunned in 1965 to discover that Alexander Kerensky, alive, well, and living as a Russian émigré in New York, had just written a book. Kerensky, the man who preceded the Bolsheviks in 1917? Kerensky, so linked with Lenin and times long past in my thoughts, still among us? (He died, in fact, in 1970, at age 89.)

Last month, on a ship headed for the Galápagos Islands, I encountered an incongruity that struck me just as forcefully. I was listening to a lecture when a throwaway line cut right into me. "Louis Agassiz," the man said, "visited the Galápagos and made scientific collections there in 1872." What? The primal creationist, the last great holdout against Darwin, in the Galápagos, the land that stands for evolution and prompted Darwin's own conversion? One might as well let a Christian into Mecca. It seems as incongruous as a president of the United States portraying an inebriated pitcher in the 1926 World Series.

Louis Agassiz was, without doubt, the greatest and most influential naturalist of nineteenth-century America. A Swiss by birth, he was the first great European theorist in biology to make America his home. He had charm, wit, and connections aplenty, and he took the Boston Brahmins by storm. He was an intimate of Emerson, Longfellow, and anyone who really mattered in America's most patrician town. He published and raised money with equal zeal and virtually established natural history as a professional discipline in America; indeed, I am writing this article in the great museum that he built.

But Agassiz's summer of fame and fortune turned into a winter of doubt and befuddlement. He was Darwin's contemporary (two years older), but his mind was indentured to the creationist world view and the idealist philosophy that he had learned from Europe's great scientists. The erudition that had so charmed America's rustics became his undoing; Agassiz could not adjust to Darwin's world. All his students and colleagues became evolutionists. He fretted and struggled, for no one enjoys being an intellectual outcast. Agassiz died in 1873, sad and intellectually isolated but still arguing that the history of life reflects a preordained, divine plan and that species are the created incarnations of ideas in God's mind.

Agassiz did, however, visit the Galápagos a year before he died. My previous ignorance of this incongruity is at least partly excusable, for he never breathed a word about it in any speech or publication. Why this silence, when his last year is full of documents and pronouncements? Why was he there? What impact did those finches and tortoises have upon him? Did the land that so inspired Darwin, fueling his transition from prospective preacher to evolutionary agnostic, do nothing for Agassiz? Is not this silence as curious as the basic fact of Agassiz's visit? These questions bothered me throughout my stay in the Galápagos, but I could not learn the answers until I returned to the library that Agassiz himself had founded more than a century ago.

Agassiz's friend Benjamin Peirce had become Superintendent of the Coast Survey. In February of 1871, he wrote to Agassiz offering him the use of the *Hassler*, a steamer fit for deep-sea dredging. I suspect that Peirce had a strong ulterior motive beyond the desire to collect some deep-sea fishes: he hoped that Agassiz's intellectual stagnation might be broken by a long voyage of direct exposure to nature. Agassiz had spent so much time raising money for his museum and politicking for natural history in America that his contact with organisms other than the human kind had virtually ceased. Agassiz's life now belied his famous motto: study nature, not books. Perhaps he could be shaken into modernity by renewed contact with the original source of his fame.

Agassiz understood only too well and readily accepted Peirce's offer. Agassiz's friends rejoiced, for all were saddened by the intellectual hardening of such a great mind. Darwin himself wrote to Agassiz's son: "Pray give my most sincere respects to your father. What a wonderful man he is to think of going round Cape Horn; if he does go, I wish he could go through the Strait of Magellan." The *Hassler* left Boston in December 1871, moved down the eastern coast of South America, fulfilled Darwin's hope by sailing through the Strait of Magellan, passed up the west-

ern coast of South America, reached the Galápagos (at the Equator, 600 miles off the coast of Ecuador) on June 10, 1872, and finally docked at San Francisco on August 24.

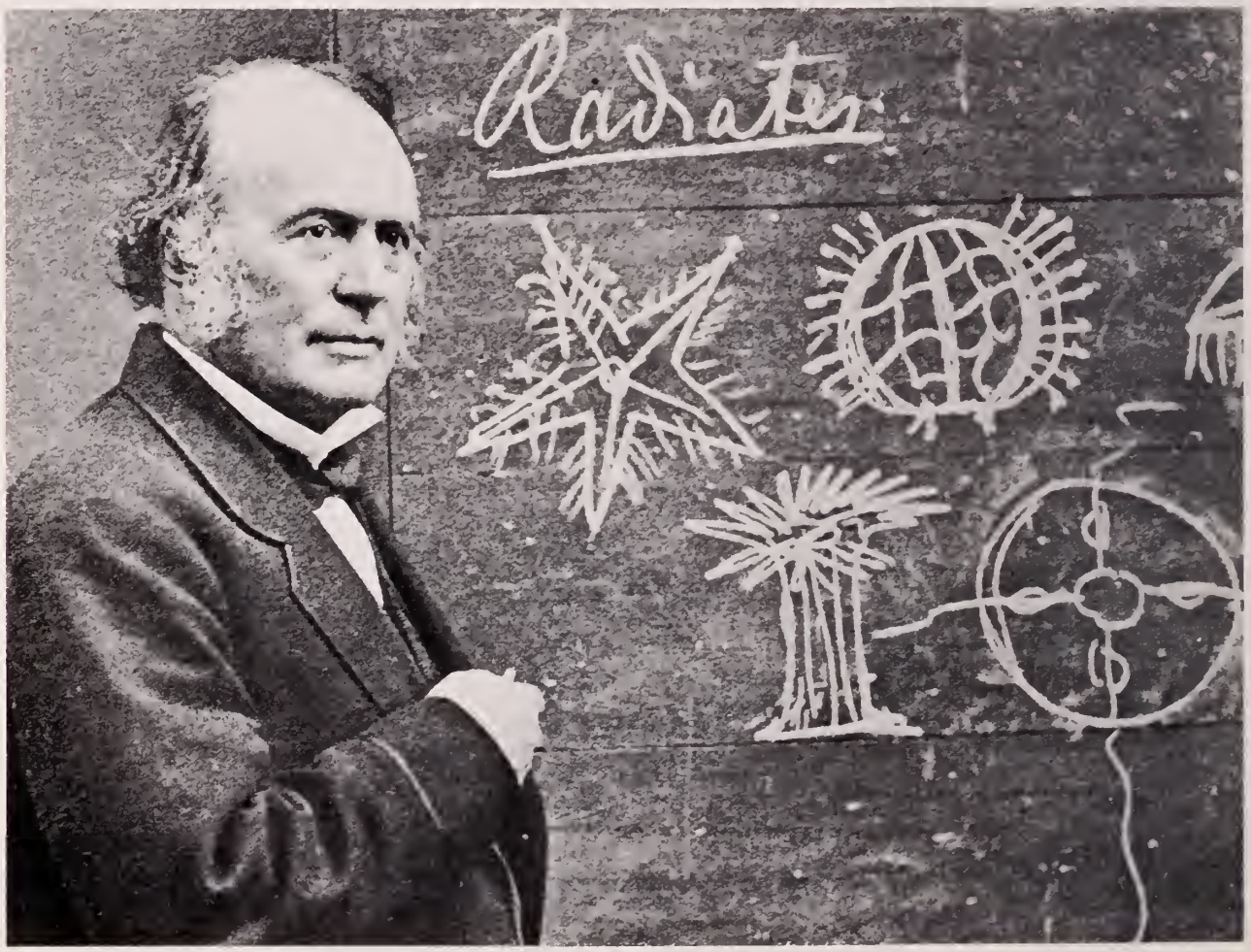
A possible solution to the enigma of Agassiz's silence immediately suggests itself. The Galápagos are pretty much "on the way" along Agassiz's route. Perhaps the *Hassler* only stopped for provisions—just passing by. Perhaps the cruise was so devoted to deep-sea dredging and Agassiz's observations of glaciers in the southern Andes that the Galápagos provided no special interest or concern.

This easy explanation is clearly incorrect. In fact, Agassiz planned the *Hassler* voyage as a test of evolutionary theory. The dredging itself was not designed merely to collect unknown creatures but to gather evidence that Agassiz hoped would establish the continuing intellectual validity of his lingering creationism. In a remarkable letter to Peirce, written just two days before the *Hassler* set sail, Agassiz stated exactly what he expected to find in the deep dredges.

Agassiz believed that God had ordained a plan for the history of life at the beginning and then proceeded to create species in the appropriate sequence throughout geological time. God matched environments to the preconceived plan of creation. The fit of life to environment does not record the evolutionary tracking of changing climates by organisms but rather the construction of environments by God to fit the preconceived plan of creation: "the animal world designed from the beginning has been the motive for the physical changes which our globe has undergone," Agassiz wrote to Peirce. He then applied this curiously inverted argument to the belief, then widespread but now disproved, that the deep oceans formed a domain devoid of change or challenge—a cold, calm, and constant world. God could only have made such an environment for the most primitive creatures of any group. The deep oceans would therefore harbor living representatives of the simple organisms found fossil in ancient rocks. Since evolution demands progressive change through time, the persistence of these simple and early forms will demonstrate the bankruptcy of Darwinian theory. (I don't think Agassiz ever understood that the principle of natural selection does not predict global and inexorable progress but only adaptation to local environments. The persistence of simple forms in a constant deep sea would have satisfied Darwin's evolutionary theory as well as Agassiz's God. But the depths are not constant, and their life is not primitive.)

The letter to Peirce displays that mixture of psychological distress and intellectual pugnacity so characteristic of Agassiz's opposition to evolution in his later years. He knows that the world will scoff at his preconceptions, but he will pursue them to the point of specific predictions nonetheless—the discovery of "ancient" organisms alive in the deep sea:

> I am desirous to leave in your hands a document which may be very compromising for me, but which I nevertheless am determined to write in the hope of showing within what limits natural history has advanced toward that point of maturity when



Until his death in 1873, Louis Agassiz argued against the theory of evolution. AMNH

FORD MUSTANG

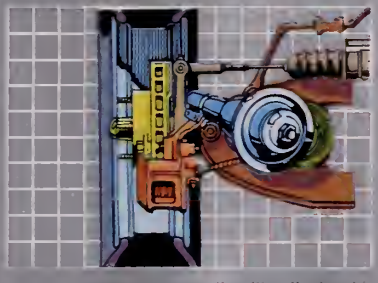
From simmer to sizzle.

Whether you choose the simmer of Mustang L or the sizzle of Mustang GT, you can be sure of one thing: excitement is not far behind.*

Your kind of sizzle.

Inside Mustang's slick aerodynamic shape lives a finely engineered power plant. Choose from the standard 2.3 liter 4-cylinder with optional 5-speed transmission, all the way up to the 5.0 liter High-Output engine, that's designed and built to be a performer. Coupled with Mustang's standard rack and pinion steering and modified MacPherson strut suspension—we've got your performance needs covered.





*Mustang model availability limited in some states. See your dealer for details.



Options. Whatever you choose, you're going to be right.

Inside Mustang you'll find impressive comfort and convenience. Maybe you'll go for the leather-wrapped steering wheel surrounded by an easy-to-read instrument cluster. Or maybe you'll turn up the heat with an AM/FM stereo radio with cassette tape, coupled with Ford's Premium Sound System, then choose air conditioning to cool things down. But whatever you choose you're going to be right.

We've got you covered for good mileage.

Mustang is aerodynamically designed to move freely through the streets while squeezing every drop of fun out of a gallon of gas.

33 EST HWY **22** EPA EST MPG

For comparison. Your mileage may differ depending on speed, distance and weather. Actual highway mileage lower.

And sometimes, we've even got you uncovered.

The optional T-Roof makes Mustang an excellent place to watch the world watch you back.



Whether you buy or lease, see Mustang at your Ford Dealer now.

FORD MUSTANG

FORD DIVISION Ford



LOOK OUT WORLD
HERE COMES FORD

Ford

science may anticipate the discovery of facts. If there is, as I believe to be the case, a plan according to which the affinities among animals and the order of their succession in time were determined from the beginning . . . if this world of ours is the work of intelligence, and not merely the product of force and matter, the human mind, as a part of the whole, should so chime with it, that, from what is known, it may reach the unknown.

But Agassiz did not sail only to test evolution in the abstract. He chose his route as a challenge to Darwin, for he virtually retraced—and by conscious choice—the primary part of the *Beagle*'s itinerary. The Galápagos were not a convenient way station but a central part of the plot. His later silence becomes more curious.

The *Beagle* did circumnavigate the globe, but Darwin's voyage was basically a surveying expedition of the South American coast. Agassiz's route therefore retraced the essence of Darwin's pathway—physically if not intellectually. One cannot read Elizabeth Agassiz's account of the *Hassler* expedition (published in her official biography of her husband) without recognizing the uncanny (and obviously not accidental) similarity with Darwin's famous account of the *Beagle*'s voyage. (Elizabeth accompanied Louis on the trip.) Darwin concentrated primarily upon geology and so did Agassiz. The trip may have been advertised as a dredging expedition, but Agassiz was most interested in reaching southern South America to test his theory of a global ice age. He had studied glacial striations and moraines in the Northern Hemisphere and had determined that a great ice sheet has descended from the north. (Striations are scratches on bedrock made by pebbles frozen into the bases of glaciers. Moraines are hills of debris pushed by flowing ice to the fronts and sides of glaciers.) If the ice age had been global, striations and moraines in South America would indicate a spread from Antarctica at the same time. Agassiz's predictions were, in this case, upheld—and he exulted in copious print (faithfully transcribed by Elizabeth and published in the *Atlantic Monthly*).

Darwin was appalled by the rude life and appearance of the "savage" Fuegians and so was Agassiz. Elizabeth recorded their joint impressions: "Nothing could be more coarse and repulsive than their appearance, in which the brutality of the savage was in no way redeemed by physical strength or manliness. . . . They scrambled and snatched fiercely, like wild animals, for whatever they could catch."

If there be any lingering doubt about Agassiz's conscious decision to evaluate Darwin by retracing his experiences, consider this passage, written at sea to his German colleague Carl Gegenbaur:

I have sailed across the Atlantic Ocean through the Strait of Magellan, and along the western coast of South America to the northern latitudes. Marine animals were, naturally, my primary concern, but I also had a special purpose. I wanted to study the entire Darwinian theory, free from all external influences and former surroundings. Was it not on a similar voyage that Darwin developed his present opinions! I took few books with me . . . primarily Darwin's major works.

I can find few details about Agassiz's stay in the Galápagos. We know that he arrived on June 10, 1872, spent a week or more, and visited five islands, one more than Darwin did. Elizabeth claims that Louis "enjoyed extremely his cruise among these islands of such rare geological and zoological interest." We know that he collected (or rather sat on the rocks while his assistants gathered) the famous iguanas that go swimming in the ocean to eat marine algae (some of his specimens are still in glass jars in our museum). We know that he crossed and greatly admired the bare fields of recently cooled ropy lava "full of the most singular and fantastic details." I walked across a similar field, which Agassiz could not have seen since it formed during the 1890s. I was mesmerized by the frozen signs of former activity—the undulating, ropy patterns of flow, the burst bubbles, and lengthy cracks of contraction. And I saw Pele's tears, the most beautiful geological object, at small scale, that I have ever witnessed. When highly liquid lava is ejected from small vents, it may emerge as droplets of basalt that build drip castles of iridescent stone about their outlet—tears from Pele, the Hawaiian goddess of volcanoes (not from Martinique's Mount Pelée, which has an extra *e*).

Thus, I return to my original inquiry: if Agassiz went to the Galápagos as a central part of his plan to evaluate evolution by putting himself in Darwin's shoes, what effect did Darwin's most important spot have upon him? In response to this question we have only Agassiz's public silence (and one private communication, to which I will shortly return).

Two nonintellectual reasons may partly explain Agassiz's uncharacteristic reticence. First, despite his productive observations on South American glaciers, the *Hassler* expedition was basically a failure and a profound disappointment—and Agassiz may have chosen largely to forget about it. The dredging equipment never worked properly, and Agassiz recovered no specimens from the deepest oceans. The crew tried its best, but the ship was a misery. Jules Marcou, Agassiz's faithful biographer, wrote: "It was a great, almost a cruel, carelessness to embark a man so distinguished, so old [Agassiz was 64; perhaps concepts of age have changed], and so much an invalid as Agassiz was, in an unseaworthy craft, sailing under the United States flag."

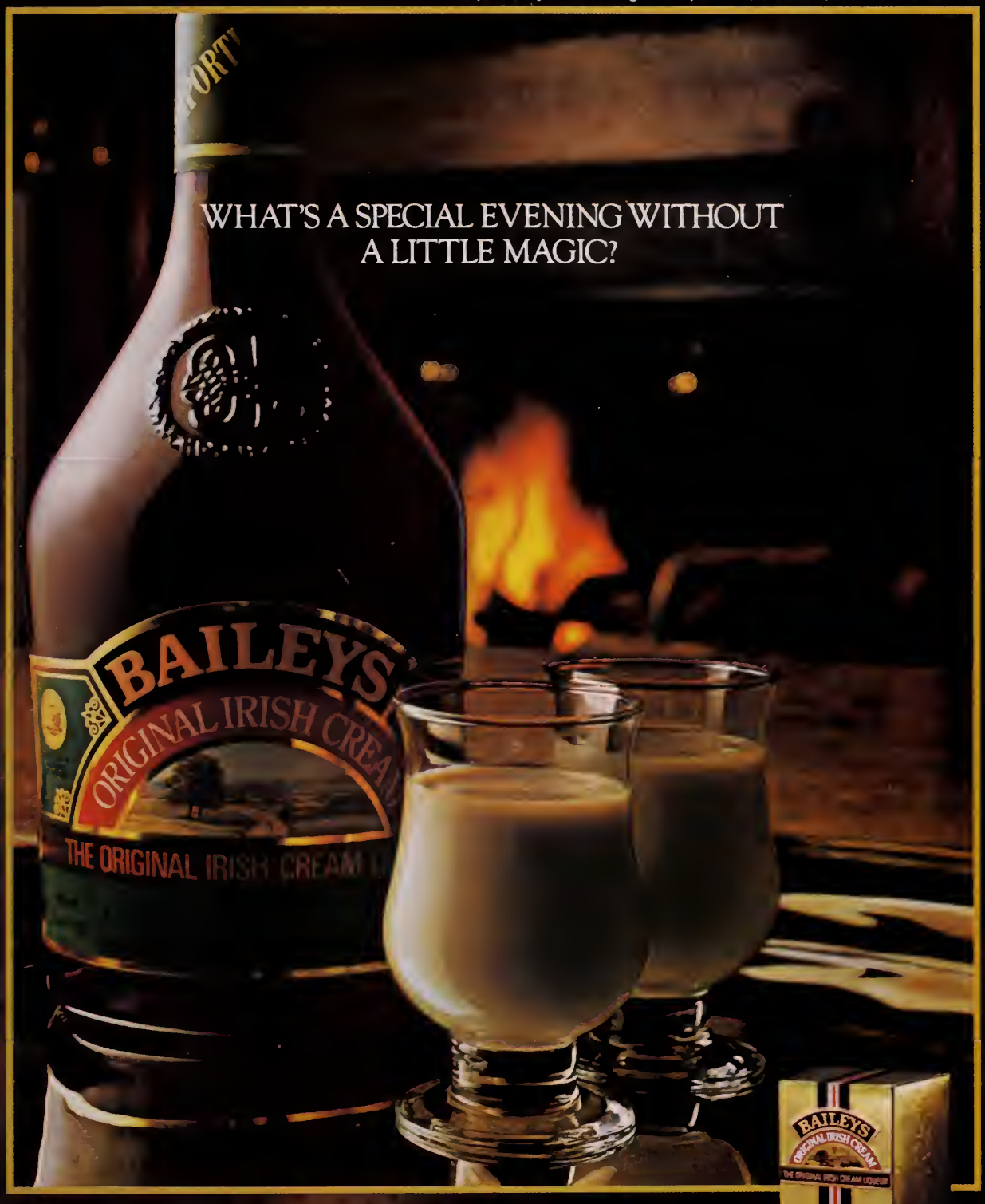
Secondly, Agassiz was ill during much of the voyage, and his listlessness and discomfort increased as he left his beloved southern glaciers and moved into the sultry tropics. (The Galápagos, however, despite their equatorial location, lie in the path of a cool oceanic current and are generally temperate; the northernmost species of penguin inhabits its shores.) Shortly after his return to Harvard, Agassiz wrote to Pedro II, emperor of Brazil (and an old buddy from a previous voyage):

When I traversed the Strait of Magellan . . . work again became easy for me. The beauty of its sites, the resemblance of the mountains to those of Switzerland, the interest that the glaciers awakened in me, the happiness in seeing my predictions affirmed beyond all my hopes—all these conspired to set me on the right course again, even to rejuvenate me. . . . Afterwards, I gradually declined as we advanced towards the tropical regions; the heat exhausted me greatly, and during the month that we spent in Panama I was quite incapable of the least effort.

(For all citations from letters, I have relied upon the originals in Harvard's Houghton Library; none have been published in full before, although several have been excerpted in print. Agassiz wrote with equal facility in French [to Pedro II], German [to Gegenbaur], and English [to Peirce], and I have supplied the translations. I thank my secretary Agnes Pilot for transcribing the Gegenbaur letter into sensible Roman. Agassiz wrote it in the old German script that is all squiggles to me.)

So far as I can tell, Agassiz's only statement about the Galápagos occurs in a private letter to Benjamin Peirce, composed at sea on July 29, 1872, the day after he had written to Gegenbaur (and said nothing about the Galápagos). The letter begins with the lament of all landlubbers: "I fancy this note may

Imported by The Paddington Corporation, New York, N.Y. 34 Proof © 1981



Baileys. A unique taste so silken, so full of character, only one word can describe it. Magic.

Perhaps it's that taste of magic that has made Baileys America's fastest growing liqueur.

BAILEYS. TASTE THE MAGIC.

reach you in Martha's Vineyard, and I heartily wish I could be there with you, and take some rest from this everlasting rocking." Agassiz continues with his only statement:

Our visit to the Galapagos has been full of geological and zoological interest. It is most impressive to see an extensive archipelago, of most recent origin, inhabited by creatures so different from any known in other parts of the world. Here we have a positive limit to the length of time that may have been granted for the transformation of these animals, if indeed they are in any way derived from others dwelling in different parts of the world. The Galapagos are so recent that some of the islands are barely covered with the most scanty vegetation, itself peculiar to these islands. Some parts of their surface are entirely bare, and a great many of the craters and lava streams are so fresh, that the atmospheric agents have not yet made an impression on them. Their age does not, therefore, go back to earlier geological periods; they belong to our times, geologically speaking; Whence, then, do their inhabitants (animals as well as plants) come? If descended from some other type, belonging to any neighboring land, then it does not require such unspeakably long periods for the transformation of species as the modern advocates of trans-



Agassiz's friend Benjamin Peirce, right, arranged for his voyage to the Galâpagos.

The Granger Collection

WE'RE EXXON

We're Jay Stone, making waves in the search for oil.



Finding new oil is one of America's most difficult energy problems. Jay Stone has eased that problem by helping design high-tech trucks that carry unique seismic devices for vibrating the earth.

Unlike similar devices, these Broad Band Vibrators can send much more powerful seismic waves into the ground. And give us a more accurate picture of the rock structures that lie beneath the earth's surface.

By studying charts of the returning echoes, Exxon's explorers can find the areas most likely to harbor oil, and determine the best sites for drilling wells.

Jay Stone's work on Exxon's seismic trucks is helping America reduce its chance of coming up dry in the search for oil and gas. And Stone is just one of thousands of Exxon people who are extending America's reach for American energy.

We're more than 100,000 people working on energy.

EXXON

mutation claim; and the mystery of change, with such marked and characteristic differences between existing species, is only increased, and brought to level with that of creation. If they are autochthones, from what germs did they start into existence? I think that careful observers, in view of these facts, will have to acknowledge that our science is not yet ripe for a fair discussion of the origin of organized beings.

The quotation is long, but it is, so far as I know, exclusive. Its most remarkable aspect is an extreme weakness, almost speciousness, of argument. Agassiz makes but a single point: many animals of the Galápagos live nowhere else. Yet the islands are so young that a slow process of evolution could not have transformed them from related ancestors in the time available. Thus, they were created where we find them (the obvious bottom line, despite Agassiz's final disclaimer that we know too little to reach any firm conclusion).

Two problems: First, although the Galápagos are young (two to five million years for the oldest islands by current reckoning), they are not so pristine as Agassiz indicates. In the letter, Agassiz describes lava flows of the past hundred years or so, and these are virtually devoid of vegetation and so fresh that one can almost see the flow and feel the heat. But Agassiz surely knew that several of the islands (including some on his itinerary) are more densely vegetated and, although not ancient, were surely not formed in a geological yesterday.

Second, Agassiz leaves out the most important aspect of Darwin's argument. The point is not that so many species of the Galápagos are unique but rather that their nearest relatives are invariably found on the adjacent South American mainland. If God created the Galápagos species where we find them, why did he imbue them with signs of South American affinity (especially since the temperate climates and lava habitats of the Galápagos are so different from the tropical environments of the ancestral forms). What sense can such a pattern make unless the Galapagian species are modified descendants of South American forms that managed to cross the oceanic barrier? Darwin wrote in the *Voyage of the Beagle*:

> Why, on these small points of land, which within a late geological period must have been covered by the ocean, which are formed by basaltic lava, and therefore differ in geological character from the American continent, and which are placed under a peculiar climate,—why were their aboriginal inhabitats . . . created on American types of organization.

And the famous, poetic statement earlier in the chapter: "We seem to be brought somewhat near to the great fact—that mystery of mysteries—the first appearance of new beings on this earth."

Agassiz could not have misunderstood, for, like Darwin, he was a professional biogeographer who, unlike Darwin, had used arguments of geographical distribution as his primary defense for creationism. Why did he skirt Darwin's principal argument? Why did he say so little about the Galápagos and argue so poorly?

I think that we must consider two possibilities as resolutions to the conundrum of Agassiz's silence (or failure to consider the critical points in his one private statement). Perhaps he knew that his argument to Peirce was hokey and inadequate. Perhaps the Galápagos, and the entire *Hassler* voyage, had produced the same change of heart that Darwin had experienced in similar circumstances and Agassiz simply couldn't muster the courage to admit it.

I cannot accept such a resolution. As I said earlier, we see abundant signs of psychological distress and deep sadness in Agassiz's last defenses of creationism. No one enjoys being an intellectual outcast, especially when cast in the role of superannuated fuddy-duddy (the part of ignored but prophetic seer at least elicits moral courage). Yet, however weak his arguments (and they deteriorated as the evidence for evolution accumulated), I sense no failure of Agassiz's resolve. The letter to Peirce seems to represent still another of Agassiz's flawed, but perfectly sincere, defenses of an increasingly indefensible, yet steadfastly maintained, view of life. (Agassiz's last article, posthumously published in the *Atlantic Monthly* in 1874, was a ringing apologia for creationism entitled: "Evolution and Permanence of Type.")

I think that we must accept the second resolution: Agassiz said so little about the Galápagos because his visit made preciously little impact upon him. The message is familiar but profound nonetheless. Scientific discovery is not a one-way transfer of information from unambiguous nature to minds that are always open. It is a reciprocal interaction between a multifarious and confusing nature and a mind sufficiently receptive (as many are not) to extract a weak but sensible pattern from the prevailing noise. There are no signs on the Galápagos that proclaim: Evolution at work. Open your eyes and ye shall see it. Evolution is an inescapable inference, not a raw datum. Darwin, young, restless, and searching, was receptive to the signal. Agassiz, committed and defensive, was not. Had he not already announced in the first letter to Peirce that he knew what he must find? I do not think he was free to reach Darwin's conclusions, and the Galápagos Islands, therefore, carried no important message for him. Science is a balanced interaction of mind and nature.

Agassiz lived for little more than a year after the *Hassler* docked. James Russell Lowell, traveling abroad, learned of his friend's death from a newspaper and wrote in poetic tribute (quoted from E. Lurie's fine biography of Agassiz, *Louis Agassiz: A Life in Science*, University of Chicago Press, 1960):

> . . . with vague, mechanic eyes,
> I scanned the festering news we half despise
> When suddenly,
> As happens if the brain, from overweight
> Of blood, infect the eye,
> Three tiny words grew lurid as I read,
> And reeled commingling: Agassiz is dead!

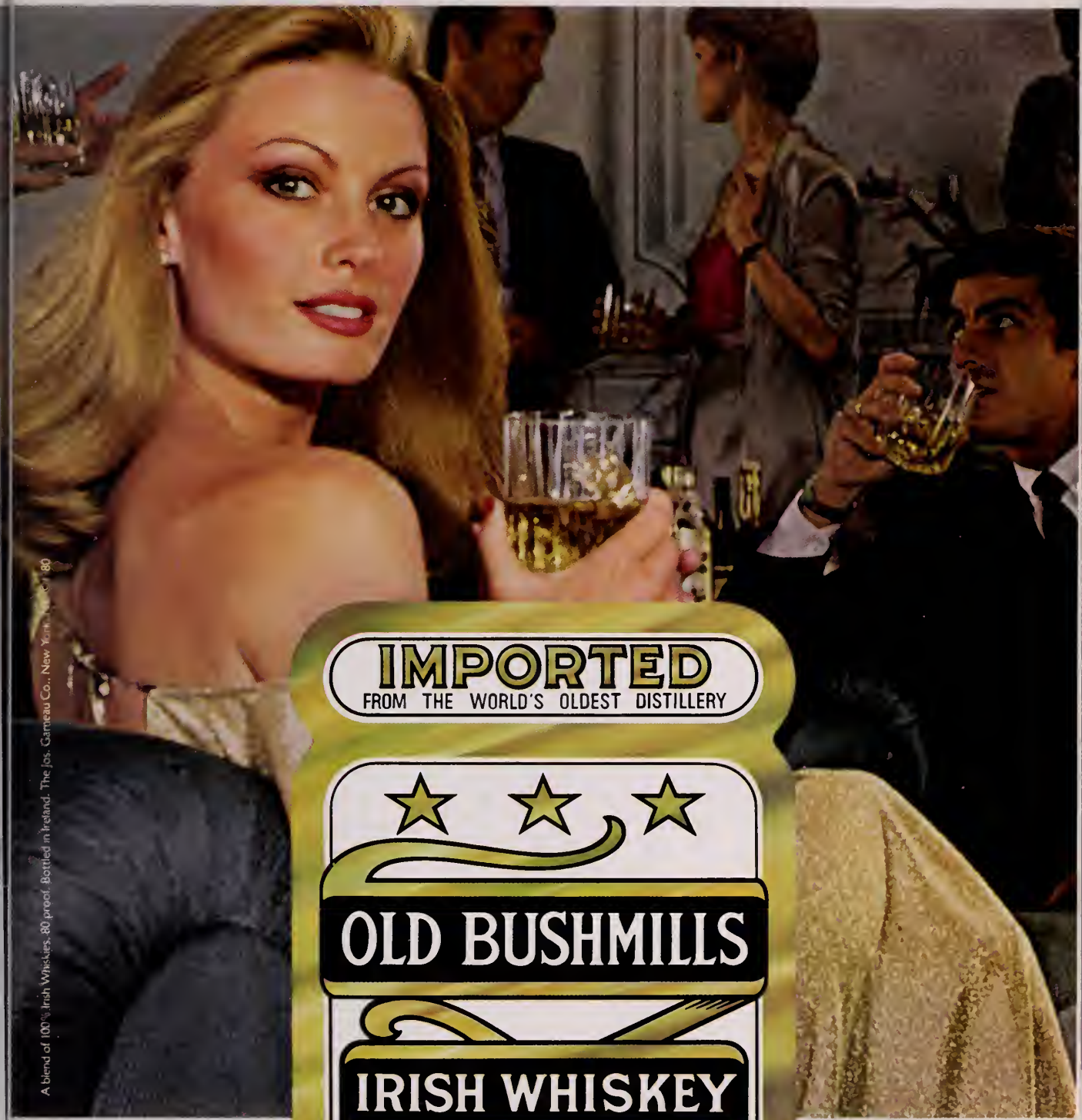
I do not know. Perhaps a bit of his incorporeal self went up to a higher realm, as some religions assert. Perhaps he saw there old Adam Sedgwick, the great British geologist (and reverend), who at age 87 wrote to Agassiz a year before the *Hassler* sailed:

> It will never be my happiness to see your face again in this world. But let me, as a Christian man, hope that we may meet hereafter in heaven, and see such visions of God's glory in the moral and material universe, as shall reduce to a mere germ everything which has been elaborated by the skill of man.

Be that as it may, Agassiz's ideas had suffered an intellectual death before he ever reached the Galápagos. Life is a series of trades. We have lost the comfort of Agassiz's belief that a superior intelligence directly regulates every step of life's history according to a plan that places us above all other creatures. ("If it had been otherwise," Agassiz wrote to Pedro II in June 1873, "there would be nothing but despair.") We have found a message in the animals and plants of the Galápagos, and all other places, that enables us to appreciate them, not as disconnected bits of wonder, but as integrated products of a satisfactory and general theory of life's history. That, to me at least, is a good trade.

Stephen Jay Gould teaches biology, geology, and the history of science at Harvard University.

Old Bushmills.
It's changing people's minds about Irish Whiskey.



A blend of 100% Irish Whiskies. 80 proof. Bottled in Ireland. The Jos. Gamleau Co., New York, N.Y. © '80

For free food and drink recipes, write to Old Bushmills, P.O. Box 639, New York, New York 10018. To send Old Bushmills anywhere in the country, call toll free: (800) 528-6148. Void where prohibited.

Experience the taste that experience created. Old Bushmills. Since 1608.

Early Bird Photographers

Seventy-five years ago, two young men braved storms, cliffs, and mosquitoes to photograph birds—and sometimes themselves

by Worth Mathewson and Margaret Thompson Mathewson

To the student of nature of three generations ago, the names of William L. Finley and Herman T. Bohlman were instantly recognizable. Today, Bohlman is almost entirely forgotten, and save for the William L. Finley National Wildlife Refuge south of Corvallis, Oregon, and a rather obscure memorial marker at the edge of a vast desert marsh named Malheur in southeastern Oregon, Finley's name too has faded from the public memory. Their contributions to the young art of bird photography, however, and Finley's efforts on behalf of conservation both in his home state of Oregon and on the national level should have earned them a permanent place in the minds of all interested in natural history and concerned with the preservation of wildlife.

Finley and Bohlman were boyhood friends in Portland in the last quarter of the nineteenth century. Bohlman had a camera and Finley an interest in birds. During the years 1898 to 1912, they worked closely together on several photography projects that gained fame for Finley and that, by calling the attention of the American public and Pres. Theodore Roosevelt to the plight of our native birds, advanced the cause of wildlife protection. Finley came to be known as a dedicated conservationist through photographs (produced first in collaboration with Bohlman and later on his own), writings, films, and political activities. Bohlman (who went on to become a plumber and a landscape painter) never achieved the national recognition that Finley enjoyed for most of his life, but the excellent photographs of the early period were clearly the result



All photographs from the Oregon Historical Society

William L. Finley (center), Herman T. Bohlman (right), and an unidentified colleague wade to a hawk's nest in 1902.

Please send me information regarding the tours I have checked.

- ☐ **Archeology Tour to Mexico** January 11 to 29, 1982
- ☐ **Ancient Maya Archeology** February 1 to 18, 1982
- ☐ **East African Safaris** February 3 to 21, 1982
  February 24 to March 14, 1982
- ☐ **Nile Cruise** February 7 to 27, 1982
- ☐ **Indonesian Odyssey** February 21 to March 13, 1982
- ☐ **Art and Archeology Tours to China** March 23 to April 15, 1982
  April 7 to May 3, 1982
  September 16 to October 13, 1982
- ☐ **Anthropology Tour to Morocco** April 4 to 17, 1982
- ☐ **Galapagos Islands Cruise** June 6 to 17, 1982
- ☐ **Alaskan Wildlife Adventure** June 25 to July 12, 1982
- ☐ **Adriatic and Aegean Adventure** August 31 to September 16, 1982
- ☐ **1982 General Program**



American Museum of Natural History

Discovery Tours

Central Park West at 79 St
New York, NY 10024
(212) 873-1440

Name (please print) _____

Address _____

City _____ State _____ Zip _____

No Postage
Necessary
If Mailed
In The
United States

Business Reply Card
First Class Permit No. 2984 N Y . N Y

postage will be paid by



American
Museum of
Natural
History

Discovery Tours

Central Park West at 79th Street
New York, New York 10024

AMERICAN MUSEUM OF NATURAL HISTORY
Vacations on sea and land with Museum Lecturers



NILE CRUISE: Explore the astounding ancient sites and natural wonders of Egypt with a Museum geologist, ornithologist illustrator, and Egyptologist. Cruise 600 miles on the Nile from Cairo to Assuan aboard the custom-built, air-conditioned *Nile Star* stopping at all the important sites which have intrigued visitors since their construction.

INDONESIAN ODYSSEY: Cruise through the paradise islands of Bali, Java, Komodo, Sulawesi, Lombok, Flores, Butung, the Moluccas and Luciparas aboard the luxury vessel, *Regina Maris*. Share with a Museum astronomer, anthropologist, ornithologist, geologist/volcanologist, and herpetologist a unique, in-depth travel experience. The itinerary takes you to lush tropical landscapes with exotic peoples influenced for centuries by India, Islam and Europe.

GALAPAGOS ISLANDS CRUISE: Discover a special natural world with fantastically tame and exotic animals such as sea lions, giant tortoises, marine and land iguanas and countless rare and beautiful birds. Enjoy the expertise of a Museum ornithologist and herpetologist and four local naturalists as we cruise through this equatorial archipelago which so influenced Darwin.

ADRIATIC AND AEGEAN ADVENTURE: Relive the great historical travels of the Greeks, Romans, Phoenicians and Venetians. Follow their paths on a classical cruise starting in Venice and going to Dubrovnik, Corfu, Corinth, Crete, Rhodes, Tunis, Carthage, Malta, Sicily, Pompeii, Herculaneum and Naples. The *Orpheus* will be your home for 14 beautiful days; the Museum faculty will be outstanding.

LAND PROGRAMS: Seven outstanding overland itineraries have been custom-designed for small groups of 15-25 participants. Famous and remote sites and cultures are discovered while staying at the finest accommodations available with expert Museum Lecturers.

DESTINATION	1982 Dates
Archeology Tour to Mexico	January 11 to 29
Ancient Maya Archeology	February 1 to 18
East African Safaris	February 3 to 21
	February 24 to March 14
Nile Cruise	February 7 to 27
Indonesian Odyssey	February 21 to March 13
Art and Archeology Tours to China	March 23 to April 15
	April 7 to May 3
	September 16 to October 13
Anthropology Tour to Morocco	April 4 to 17
Galapagos Islands Cruise	June 5 to 17
Alaskan Wildlife Adventure	June 25 to July 12
Adriatic and Aegean Adventure	August 31 to September 16

For further information concerning the Discovery Tours program mail the attached card to the Museum's travel office or call (212) 873-1440.

American Museum of Natural History

Discovery Tours

Central Park West at 79th Street New York N.Y. 10024
(212) 873-1440

of joint effort. Indeed, some people familiar with the team's work believe that during this time Bohlman was actually the more skilled artist.

According to Finley, the pair's first photography ventures of "any consequence" took place in the Pacific Northwest on canoe trips in the summers of 1897, 1898, and 1899. During these years, the two men established their method of working together, generally making exhaustive life histories of the birds they photographed. The first such project, and one that proved remunerative, focused on a pair of red-tailed hawks nesting in a cottonwood tree 120 feet above the Columbia River. Finley and Bohlman found the nesting area in 1898, located the actual nest in 1899, and finally accomplished the difficult climb up to the nest in 1900. Over the course of a month, they took a large number of photographs. Some, along with an article, were sold to *Country Life in America.*

The rest of the decade continued to be



In Portland, Oregon, Finley and Bohlman (with moustache) posed with flickers in 1901, below. Two years later, they scaled sheer cliffs, right, to reach sea bird nesting grounds on Three Arch Rocks, large basalt formations off the Oregon coast.

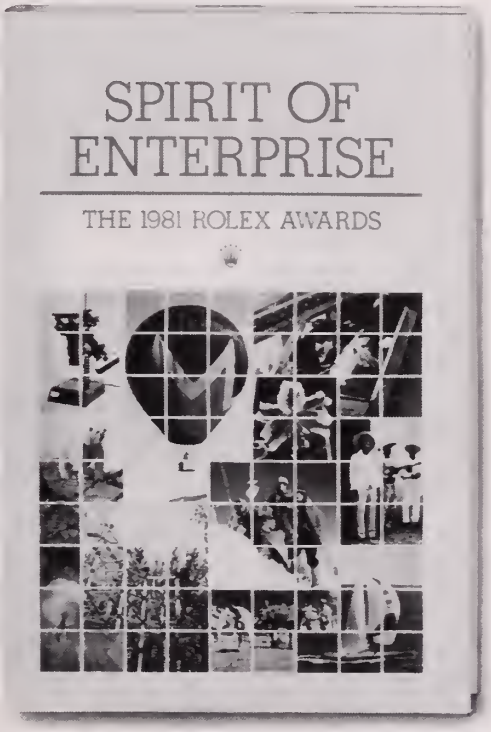


productive for Finley and Bohlman. In 1901, on their first serious photography trek out of the Portland area, they arranged for sea lion bounty hunters to ferry them out to Three Arch Rocks, three looming basalt formations that lie a mile off the north Oregon coast and are the nesting grounds of vast colonies of sea birds. The 1901 visit was short and produced few good photographs, but they returned early in the summer of 1903, equipped with boat, tent, and food for an extended stay. Rough weather forced them to camp on the beach for more than two weeks before wave action subsided sufficiently to allow them to reach the rocks, where they encountered great numbers of common murre, pigeon guillemot, tufted puffin, western gull, three species of cormorant, and two species of petrel. Photographing the birds required considerable agility and strength. For example, to reach a murre colony the men had to scale a sheer rock face, heavy camera gear in hand.

The next summer, Finley and Bohlman pursued golden eagles, great blue herons, and night herons in California. Earlier efforts to photograph herons in a rookery near Portland had met with only limited success because the nests were high up in tall firs. Of this experience, Finley wrote:

> The photographer had selected the most "climbable-looking" stronghold in the heronry, where the nearest tree was a hundred and thirty feet up. But after the long, arduous ascent, he found that ... fifteen feet away in the branches of an adjoining tree was a nest containing four eggs. To get this, the photographer strapped himself

A book as unique as the watch itself.



The book is Spirit of Enterprise — The 1981 Rolex Awards. And the watch, of course, is Rolex.

Simply put, we asked the worldwide scientific community for ideas that challenge the mind and quicken the heart. Projects were submitted for consideration in three broad categories: Applied Sciences and Invention, Exploration and Discovery, and The Environment.

A distinguished international committee examined thousands of entries, and, after months of deliberation, conferred five Rolex Awards for Enterprise. The prize for each Award was 50,000 Swiss francs and a gold Rolex Chronometer.

Spirit of Enterprise details the winning projects, along with hundreds of unusual, imaginative and otherwise stimulating proposals for scientific investigation.

Everything from a method that just might get useful energy from magnetism to how to save the sperm whales by cultivating a desert plant.

The Rolex Awards for Enterprise celebrate the fertility of humankind's imagination. And the book makes worthwhile, exciting reading, particularly if you're the kind of person who appreciates the spirit of Rolex itself.

Spirit of Enterprise — The 1981 Rolex Awards isn't a book for everybody. But then again, Rolex isn't a watch for everybody, either.

ROLEX



*Spirit of Enterprise — The 1981 Rolex Awards, 460 pages, suggested list price, $15.95.**
Published by W. H. Freeman and Company, 660 Market Street, San Francisco, California 94104, USA. Or through your bookstore.

carefully in the branches and wrapped his legs about the trunk. With a rope, he lassoed the broken end of a limb on the adjoining tree, and, by slipping the cord back and forth, worked the rope up to the trunk. A slow, steady pull and the tops of the trees bent closer together. The tension became stronger and stronger between the two trees, until at four feet it looked like a huge catapult that might suddenly be sprung and shoot the climber backward into space. In another instant an aerial bridge was formed in the treetop while the photographer secured his prize.

The California rookery was situated in sycamores, where nests were much more accessible. In a single tree, the two men counted forty-one blue heron nests and twenty-eight night heron nests. The photographs from this summer turned out well, but they were obtained at great personal suffering caused by thick



In 1904 the pair traveled to California, where they photographed golden eagles in the nest, right. While photographing herons, they were forced to sleep in a haystack, below, to escape hordes of mosquitoes.



stands of poison oak and mobs of mosquitoes. To escape the latter Finley and Bohlman slept in the dusty, prickly confines of a haystack.

In the spring of 1905 Finley and Bohlman traveled to Klamath Marsh in southeastern Oregon. Three years later, they visited Malheur Marsh, farther to the east at the base of steeply rising Steens Mountain. These were extended visits, each more than a month in length, and were not without hardships. The two men often slept on top of muskrat houses and were forced to deal with alkaline drinking water, hordes of insects, and sudden storms. At Klamath Lake, they landed on an island only to find it covered with fleas, and at Malheur they were lost for a full day and night in the towering tule reeds.

These two trips were taken partly at the urging of William Dutcher, president of the fledgling National Association of Audubon Societies. Dutcher wanted Finley and Bohlman to secure information and photographs for a report regarding the killing of egrets, grebes, terns, and other birds for the millinery trade. At this time, the widespread destruction of native birds for their plumage was coming increasingly under attack, and in 1910 *Atlantic*

AMERICA'S TRUCK. BUILT FORD TOUGH.



LION IN WINTER.

Bronco roars to the top nonstop. Its husky 4.9L (300) Six churns out more torque than any competitive Six. It also turns out excellent gas mileage ratings: 24 est. highway, (17) EPA est. mpg.*

Inside it's a real family 4-wheeler. There's room for six with front and rear bench seat options (front buckets are standard). But Bronco's trim outer size makes it easy to maneuver, fun to drive *wherever* you drive.

Underneath you'll find the only independent front suspension in an American-built sport utility. It's smooth *and* tough!

Mileage-boosting 4-speed overdrive, another Ford first, is optional. So are automatic locking hubs. They run free on the highway, lock in automatically when you shift to 4WD.

No other 4-wheeler offers all this. So why settle for less than Bronco—it's one beautiful beast!

*With std. 4.9L (300) Six and opt. 4-speed overdrive. Use for comparison. Your mileage may differ depending on speed, distance and weather. Actual highway mileage and California estimates lower.

FORD BRONCO

FORD DIVISION Ford



The Chivas Regal of Liqueurs.

Chivas Brothers make the world's finest Scotch.
And the same renowned Chivas quality and tradition goes into its equally-regal Lochan Ora Liqueur. With a unique taste all its own. Lochan Ora is to be lingered over—sipped slowly, savored fully. It's expensive but, then, good taste invariably is.

Lochan Ora.

The Imported Liqueur from Chivas Brothers.

70 PROOF • IMPORTED BY GENERAL WINE & SPIRITS CO., N.Y., N.Y.

Monthly published "The Trail of the Plume-Hunter," an influential article by Finley based largely on his Malheur experience. The photographs of waterfowl at Klamath and Malheur helped the Audubon cause and captured the attention of President Roosevelt, whose decision to establish the two marshes and Three Arch Rocks as federal wildlife refuges was influenced by Finley and Bohlman's work.

In 1906, between the two marsh studies, Finley embarked on the project that he and many others considered the most important of his long career. The naturalist Joseph Grinnell located a California condor's nest in the Sierra Madre Mountains and invited Finley to make a photographic study—the first done on the species, which was diminishing rapidly even then. Arriving at the nest in March within an hour or so after the young condor had hatched, Finley secured two good plates of the chick and mailed prints to Bohlman, who took three months off from work to join the expedition. In July, Finley took the young condor, which he had named General, back to Oregon and kept it at his home until the early fall; then he sent it by rail to William Hornaday, director of the New York Zoological Society.



The young condor did well for a number of years until it tragically succumbed to the effects of swallowing a rubber band.

The year 1906 also saw Finley's marriage to Irene Barhart. Finley and Bohlman worked closely together for the last time during the summer of 1912, when they revisited many of their old haunts; in subsequent years, Finley's fieldwork was primarily shared by his wife. The Finleys also wrote several books and numerous magazine articles together. For many years, Finley was a chief contributor to *Nature* magazine, which was incorporated into *Natural History* in the 1950s.

In his lifetime, Finley produced more than 50,000 still photographs (many with Bohlman) and 200,000 feet of motion picture film on various natural history subjects. His productivity was not limited, however, to photography and writing; Finley was also involved throughout his life in conservation activities. Among other appointments, Finley served as president of the Oregon Audubon Society, and vice-president of the Isaak Walton League of America and the National Wildlife Federation; he also established and headed, as state game warden, Oregon's Fish and Game Department. He spoke out perhaps most strongly for the protection of the waters and wildlife of his home state against the extremes of commercialism, but he also traveled across the country giving lectures on wildlife and conservation.

The respect with which he was looked upon is exemplified by the thoughts of the cartoonist and champion of conservation Jay Norwood ("Ding") Darling in a personal letter sent to Finley on his seventieth birthday: "Among all the friends with whom we have worked you have been the only one who was militant enough to suit me. Your vigor of statements and your vision matched the great objectives for which we fought." The photographs on these pages, which were taken in the days of close association with Bohlman, clearly show that Finley's commitment to conservation was equaled by his dedication to bird photography.

Worth Mathewson, a free-lance writer, has been a student of William Finley's life for twenty-five years. He and Margaret Thompson Mathewson, a physician, have spent many hours tracking down glass negatives, movies, and other materials pertaining to Finley and Herman T. Bohlman.





Below: Finley and Bohlman photograph a pintail duck in southeastern Oregon's Klamath Marsh in 1905. Right: Three years later they found this black-crowned night heron in Malheur Marsh, to the east.

THE WOMAN THAT NEVER EVOLVED

Sarah Blaffer Hrdy

What does it mean to be female? Sociobiologist and feminist Sarah Blaffer Hrdy shows us that evolutionary biology can provide surprising answers. She introduces us to our nearest female relatives – highly competitive, independent, sexually assertive female primates.

Hrdy proves that the sexually passive, non-competitive, all-nurturing woman of prevailing myth never could have evolved within the primate order.

"A spectacular and pioneering work!" — Jane B. Lancaster

"A stunning achievement." — Jessie Bernard, author of *The Female World*

$17.50 Illustrated

At your local bookstore, or directly from

Harvard University Press

79 Garden Street,
Cambridge, MA 02138



The perfect gift . . .

A Maine Holiday Wreath for you, your loved ones or as a business gift. Beautifully handcrafted of freshly cut naturally fragrant balsam fir boughs, pine cones, red apples and a red velveteen ribbon. About 22" diameter. Order early, avoid the rush. $18.95 each ($19.95 west of the Mississippi) includes UPS delivery and an optional gift card. Business gift quantity prices available. Tel: 207 667-5561

Master Charge, VISA, M.O. or Ck. accepted

Card No. _____

Send to:
Mr/Mrs _____

Address _____

Town/City _____ State _____ Zip _____

( ) Enclose a gift card signed _____

Maine Holiday Wreaths

243 E. Main St., Ellsworth, Me. 04605

Stellar Togetherness

Most stars in the Milky Way are members of binary or multiple systems, but no one knows exactly why

by Stephen P. Maran

Most astronomical facts are gleaned from new observations, but sometimes clever analysis of existing data discloses a significant pattern that had been overlooked. A good example is a 1974 investigation of binary stars by Virginia Trimble, an astrophysicist with the University of California at Irvine and the University of Maryland at College Park. Her study of data on what are known as spectroscopic binary stars led to a better understanding of how binary systems are formed.

A binary star, of course, consists of two stars in orbit around a mutual center of mass. A spectroscopic binary is a binary system that can be identified from the lines in its spectrum, whose wavelengths shift back and forth periodically owing to the Doppler effect as the two stars travel their orbits. Trimble analyzed the data on known spectroscopic binaries by estimating the "mass ratio" of each such binary star. This quantity is simply the mass of the "secondary," or fainter, star in the binary divided by the mass of the primary star. Thus, if the primary has twice the mass of the secondary, the mass ratio is 0.5, whereas if the two stars have equal mass, the mass ratio is 1.0.

Taking the ratio of two masses is a simple matter, but the results of Trimble's analysis were still very significant. She found that the distribution of mass ratios has two peaks: there are a large number of binaries with mass ratios close to 0.7 (meaning that the secondary star in each case has about 70 percent the mass of its primary) and there are also many binaries with mass ratios near 0.3 (the fainter star having just 30 percent the mass of the primary). By contrast, there are relatively few binaries with intermediate mass ratios, such as 0.5. The existence of two preferred values, 0.7 and 0.3, immediately suggested to Trimble that two different processes must be involved in forming binary stars. One process is apparently effective in making binaries with nearly equal masses (the 0.7 mass ratio systems), while the other process forms binaries with very unequal masses (the 0.3 mass ratio binaries).

Most stars are members of binary or multiple star systems. (Although the sun, which is single, is considered to be an average star, in this respect, it is *not* average.) The rarity of being single, which has long been suspected, was confirmed recently by several investigations carried out by Helmut A. Abt and Saul G. Levy, spectroscopists at Kitt Peak National Observatory in Tucson, Arizona.

To determine the relative occurrence of binary, triple, and quadruple star systems, Abt and Levy made thousands of spectrograms of hundreds of stars. Typically, they observed a star on twenty different nights and then compared the twenty spectra to see if their spectral lines shifted as a result of orbital motion. The results proved that single stars are indeed a minority. For example, in one 1976 study, Abt and Levy found that among stars resembling the sun (including those that are slightly hotter and brighter), 46 percent were observably binary, 9 percent were triples, and 2 percent were quadruple stars. A minority of 42 percent seemed to be single. (These numbers don't add up to 100 percent because they have been rounded off.)

Since 42 percent is not an extreme minority, one might think that the sun, as a single star, is not so unusual after all. Forty-two percent is actually an

We fly you to yesterday.



And tomorrow.

Only hours away, there are places clinging to mountain tops that were old long before the wheel was introduced. And in gleaming contrast, there are cities so modern they seem to race into the future. We take you to Quito, Guayaquil, Rio de Janeiro, Lima, Santiago, Buenos Aires, São Paulo and Panama with dependable, frequent service from New York, Los Angeles and Miami. We also serve Bogotá, Cali, Caracas, Mexico City and Nassau. They are all parts of our America. We offer tours and packages to all of them with our jungles, rivers and islands included. See your travel agent. Or write to us. Call toll-free for information and reservations: 800-327-1337. In Florida, 1-800-432-1372. In Miami, (305) 526-5734.

ECUATORIANA
the world of Ecuatoriana



Wisdom, $95

The owl, symbol of wit and wisdom, peers knowingly at its surroundings. One of seven soothing Hand Coolers from Steuben, this smooth, polished crystal creature can also control papers on your desk. 5516r Owl: Height 2¼". $95. Signed Steuben. You may order by phone: 212-752-1441. Out of State: 800-223-1234. Or write Steuben Glass, Fifth Avenue at 56th Street, New York, N.Y. 10022. Major credit cards accepted.

STEUBEN GLASS

¡Speak Spanish like a diplomat!

What sort of people need to learn a foreign language as quickly and effectively as possible? *Foreign service personnel,* that's who. Members of America's diplomatic corps are assigned to U.S. embassies abroad, where they must be able to converse fluently in every situation.

Now you can learn to speak Spanish just as these diplomatic personnel do—with the Foreign Service Institute's Programmatic Spanish Course

The U.S. Department of State has spent thousands of dollars developing this course. It's by far the most effective way to learn Spanish at your own convenience and at your own pace.

The Programmatic Spanish Course consists of a series of cassettes and accompanying textbook. Simply follow the spoken and written instructions, listening and repeating. By the end of the course, you'll be learning and speaking entirely in Spanish!

This course turns your cassette player into a "teaching machine." With its unique "programmatic" learning method, you set your own pace—testing yourself, correcting errors, reinforcing accurate responses.

This Programmatic Course comes in two volumes. Order one or both.

☐ **Volume I.**
12 cassettes, (17 hrs.), 464-page Text, and Instructor's manual, $115

☐ **Volume II.**
8 cassettes, (11½ hrs.), 614 page Text, and Instructor's manual, $98.

(Conn. and N.Y. residents add sales tax)

Shipped in handsome library binders

TO ORDER, JUST CLIP THIS AD and mail with your name and address, and a check or money order. Or, charge to your credit card (American Express, VISA, MasterCard, Diners Club) by enclosing card number, expiration date, and your signature.

The Foreign Service Institute's Spanish course is unconditionally guaranteed. Try it for three weeks. If you're not convinced it's the fastest, easiest, most painless way to learn Spanish, return it and we'll refund every penny you paid. Order today!

Many other FSI language courses also available. Write us

AUDIO-FORUM®
Audio-Forum
Dept. T-31
On The Green,
Guilford, CT. 06437
(203) 453-9794



Or visit our New York sales office: 145 E. 49th St., New York, N.Y. 10017 (212)753-1783

overestimate of the stars without companions, however, because some kinds of binary and multiple stars are hard to recognize as such (see "Searching for Dim Companions," *Natural History,* June 1981). So-called selection effects—that is, circumstances that may result in certain specimens being overlooked or underrepresented in a scientific survey—prevented Abt and Levy from identifying these difficult cases as binary or multiple stars. For example, binaries with very long orbital periods were missed because their orbital velocities are correspondingly slow and hence the Doppler shifts of their spectral lines are too small to measure. Also, if a secondary star is much less massive than its primary, the primary will orbit at very low speed while the secondary star orbits at high speed. Because the massive primary is much brighter, only its spectral lines will be detectable. The Doppler shifts of the massive primary star's spectral lines will be too small to measure and thus the binary will pass for a single star.

Still another selection effect occurs when the members of a pair orbit in a plane at nearly right angles to the line of sight from the earth. In that case, even though a pair may zip around their orbits at high speeds, there is no significant motion toward or away from the earth and thus no observable Doppler shift. Binaries of this type are also missed.

When Abt and Levy extrapolated the observed percentages of binary and multiple sunlike stars, increasing the percentages to compensate for those missed due to selection effects, the "42 percent single" category shrank dramatically. After making these corrections, Abt and Levy concluded that nearly all stars are at least binary, with a typical star having an average of 1.4 companions. (Thus, among every ten stars seen in the sky, there will be a total of about fourteen companions.)

Abt and Levy also made another important finding that brings us back to Trimble's discovery that two distinct processes are at work making binary stars. The Arizona team studied the masses of the secondary stars in binary systems and found that there are two types of secondaries that differ according to their orbital periods. Long-period binaries (those whose stars are widely separated from one another and whose large orbits take a century or more to complete) have secondaries that, as a class, are indistinguishable from the general population of stars in the Milky

Way. For example, among every 100 of these long-period secondaries, there are as many stars having 1 solar mass as there are among 100 stars chosen at random in the Milky Way, and there are as many stars of ½ solar mass as are found among 100 stars of the galaxy's general population. Stars with ¼ solar mass seem to be the most numerous of all in the Milky Way, and they are also the most numerous among the long-period secondaries.

But among short-period binary systems (in which the stars are fairly close together and take less than 100 years to complete their orbits), the secondaries do not have the same occurrence rates according to their masses as stars of the general Milky Way population. Instead of being most numerous at about ¼ solar mass, these secondaries tend to have masses approaching those of their primary stars. If we were to study 100 short-period primaries, each having 1 solar mass, for instance, we would find that ¼-solar-mass stars are not the most numerous among their secondaries. Instead, secondaries with closer to 1 solar mass would be the most numerous.

This distinction in the properties of mass between the secondary stars of long- and short-period binary systems was the second striking clue that two different processes form binary stars. From this second clue, we deduce that one process creates long-period binaries, in which the secondaries resemble the general population of stars. The other process, which creates the short-period binaries, somehow produces secondaries that are slightly smaller copies of their primaries.

The leading theories of binary star formation invoke the phenomena of fission, capture, fragmentation, disruption of clusters, and condensation of adjacent protostars, respectively. A star begins as a protostar, condensing from a cool nebula of gas and dust. As the protostar contracts and warms on its way to igniting nuclear reactions and becoming a real star, it spins ever faster. According to the fission theory, if the protostar spins fast enough, it will throw off matter, which then forms a companion protostar. The pair will eventually become true stars, constituting a binary system. Some astronomers believe that fission is inevitable and that it explains why almost all stars are binary or multiple. Nevertheless, there are objections to this theory. One is that tidal forces might prevent the ejected matter from condensing, just as tidal forces around Saturn seem to have prevented the particles in its rings from collecting into one or more moons. In addition, computations by Leon B. Lucy of Columbia University, an expert on binary stars, indicate that the matter ejected from a rotating protostar is sufficient only to form a secondary star with ⅛ the mass of the primary. Thus, the many close binaries whose primary and secondary stars have comparable masses could not form by fission. Finally, fission could not hurl the secondary star far enough from the primary to form a long-period binary.

According to the capture theory, a binary is created when two unrelated stars happen to pass close enough to each other to enable their gravitational attraction to form a permanent bond. This theory is more applicable to the long-period binaries with their large separations than to short-period binaries that are fairly close together, because stars passing randomly in space are more likely to pass at a large distance than at a small one (just as a badly thrown dart more often hits an outer target zone than the bull's-eye). The objection to this theory is that simple analysis shows that two passing stars will almost always keep on going; capture

The Soligor 80-200mm Expand Your Horizons By Getting Close.



You've got a terrific 35mm SLR camera, but not all of your shots are terrific. Some suffer from too much unwanted scenery, some from tiny people in big frames... shots that didn't work because your creative I.Q. was more than your *lens* could handle.

That's right, lens. But, Soligor has a solution: the affordable, innovative Soligor 80-200mm One-Touch Zoom + Macro lens that lets you and your camera turn blah into beauty.

Zoom in to crop out extraneous details. Bring your subjects up to 4 times closer than a standard lens can. Frame your shots exactly as you want them, and Soligor quality captures them faithfully. Create exciting portraits, instead of just pictures of people; capture a still life or sports action as the kind of picture you bought your camera to get; experiment with amazing close-ups, thanks to macro ability. And it's all so easy with Soligor's single One-Touch control for zoom, focus and macro.

If some of the zip has gone out of your picture taking, zip down to your Soligor dealer and try our 80-200mm on your Canon, Minolta, Pentax, Olympus, Nikon or other fine camera. Or, write for full information.

SOLIGOR®
MAKES THE DIFFERENCE

AIC Photo, Inc. Carle Place, N.Y. 11514
In Canada: Kingsway Film Equipment Ltd., Ontario



Warm Feet For Men and Women

GOOSE DOWN SOX

Great travel, bed or sleeping-bag sox. Ultra-warm Bauer Goose Down is quilted in tough nylon taffeta. A pair weighs mere ounces and takes little space in luggage. Machine washable. **Colors,** Men's: Taupe, Red, Winter Blue. Women's: Winter Blue, Red, Powder Blue. **Sizes:** Men's S(6½-8), M(8½-10), L(10½-11½), XL(12-13). Women's S(5-6½), M(7-8½), L(9-10½). **$17.95** ppd.

Order Today! Money Back Guarantee!

Here is my check or money order for $_____
(Add sales tax where applicable.)

☐ **#0347 Men's Goose Down Sox**
Size_____ Color_____

☐ **#0348 Women's Goose Down Sox**
Size_____ Color_____

Name_____
Address_____
City_____
State_____ Zip_____

☐ **Send me your FREE outdoor catalog.**

Eddie Bauer®

Dept. NNH, Fifth & Union, Seattle, WA 98124



The true story of the gorilla who can chat, tease, argue, joke, question, insult— and even lie.

"*The Education of Koko* is more than a charming story about animals; it is a valuable tool in our exploration of how we learn to communicate, how we, as well as apes, learn language."
—*Publishers Weekly*

THE EDUCATION OF
KOKO
by Francine Patterson and Eugene Linden

Main Selection of Book-of-the-Month Club: Science
Alternate Selection of Book-of-the-Month and Natural Science Book Clubs

$15.95 Holt, Rinehart & Winston

only occurs when an additional force (other than the gravity of the two stars) helps to slow the pair down. One suggested additional force is the gravity of a third star that may be nearby. But close approaches of one star to another are very rare and a three-way close approach would be extremely unlikely among unrelated stars. Two stars that already compose a binary system might be able to capture a third star and form a triple system, but at first glance, capture is an improbable way to form a binary to begin with.

In the fragmentation theory, a protostar does not condense toward the center, as is assumed in the fission theory. Instead, the protostar is supposedly shaped like a huge torus, or doughnut, and eventually breaks up into several fragments. Two of the fragments condense and form a binary star. Computer calculations by Lucy, which start out with the hypothesized torus, show that the protostar fragments can form a short-period binary. Further, in contradistinction to the fission theory, fragmentation does seem capable of making binaries with nearly equal masses. We are not certain, however, that protostars will form toruses rather than condensing toward their centers.

The theory that binary stars form by cluster disruption assumes that the members of a small star cluster escape, leaving just two stars, which then constitute a binary. There is more to it, but that is the general idea. This theory begs the question of how the cluster itself formed. Further, if virtually all stars are at least binary, as determined by Abt and Levy, then how do the escaped stars get their companions?

Finally, the theory that binary systems are created by the condensation of adjacent protostars is the least profound of all. It postulates that from a single nebula two protostars condense close enough to each other to enable gravity to make them a binary star. This theory is applicable to widely separated, long-period binary stars: protostars are so much larger than the stars they eventually become that if two protostars were close enough to form a close binary, they might merge into a single protostar or tidally disrupt each other.

What if two protostars formed at distant locations within a large nebula and then happened to pass each other? One star might capture the other since the nebula would be a retarding medium, and the retardation could constititute the additional force that (as explained above) is necessary for the capture process. This variant of the capture theory could account for the formation of long-period binaries with their unrelated secondary and primary star masses.

The work of Trimble, Abt, and Levy tells us that two processes are at work, forming two different kinds of binary stars. We are not sure how that happens, but another process—the process of elimination—suggests that, among current theories, fragmentation can best account for the short-period, close binaries with their members' comparable masses. Either capture in a nebular environment or condensation of adjacent protostars may explain the long-period binaries with their unrelated masses.

In some binary systems, mass flows from one star to its partner in the form of a gas stream or of a stellar wind. This further complicates astronomers' efforts to interpret the mass ratios. Explaining exactly how a single star is born is hard enough, but binary stars are clearly double trouble.

Stephen P. Maran is a senior staff scientist in the Laboratory for Astronomy and Solar Physics at NASA's Goddard Space Flight Center in Greenbelt, Maryland.

WHEN YOU WRITE TO NATURAL HISTORY

about a change of address, renewal of subscription, billing, or any kind of adjustment, send the present address label from the magazine wrapper.

Moving? Please notify 6 weeks in advance. You can use this form to tell us about a move or order a subscription.

Change of address—Attach your address label in the dotted area and fill in your new address below, clip and mail to Natural History Membership Services, P.O. Box 4300, Bergenfield, N.J. 07621.

Cut your old address label from magazine wrapper and attach over this area
Fill in your NEW address and mail to:
Natural History Magazine
Membership Services P.O. Box 4300
Bergenfield, N.J. 07621

PLEASE PRINT

Name_____

New Address_____

City_____ State_____ Zip_____

Dewar's unto others.



The gift of Dewar's.® Good things never vary.

If you can't deliver your gift of Dewar's "White Label"® personally, we'll do it for you. Call toll free 800-528-6148 for details. Gift boxed at no extra cost.

BLENDED SCOTCH WHISKY • 86.8 PROOF • © 1981 SCHENLEY IMPORTS COMPANY N.Y., N.Y.

Whales at Table

Text and photographs by James W. Greenough

Banqueting in the cold waters off Alaska, humpback whales lunge at their prey with mouths agape

Although not a biologist by education, I am a scientist of sorts—and an inveterate observer of wildlife. I am especially excited by great whales, even though I see them routinely while running my commercial fishing boat. So when the opportunity arose to spend some time watching a group of humpback whales in southeast Alaska during late November and December 1980, I didn't turn it down. One late fall morning I transported John and Jan Straley of Sitka, Alaska, two whale observer friends, to their chosen bay off Admiralty Island.

Well known among whale watchers as the most acrobatic of the great whales, the humpback leaps into the air more than any other species. Nearly everyone interested in whales has heard of or seen the dramatic breaches of the humpback, in which thirty or forty tons of bulbous flesh erupt from the sea. Yet the humpback's most dramatic behavior may well be its eating habits. The huge humpbacks (regularly about forty feet in length and occasionally over fifty feet) feed on a variety of tiny to small organisms, the largest of which is usually the herring (sometimes up to ten or twelve inches, more commonly six inches). Needless to say, it takes a great many herring to feed one humpback whale. Specialized techniques are required to round up and capture such quantities of fish. The techniques that humpbacks have evolved are both spectacular and complex.

For three weeks we watched a group of twelve to fourteen whales surface feed continually during daylight hours. We were intrigued because it is not common knowledge that some humpbacks remain in Alaskan waters and continue to feed so late in the season. With the coming of cold weather and short daylight hours, the humpbacks generally head for warm tropical waters where they mate and rest, but do not feed. Indeed, most humpbacks had departed Alaskan waters by November, but for some reason these errant whales were still actively feeding in early December.

Humpbacks sometimes feed well below the surface in moderately deep waters, but the type of feeding we watched, known as "vertical lunge" feeding, was done at the surface. The process, as performed by one whale, is simple. The whale sounds (dives), locates a school of herring (or a dense concentration of tiny organisms such as krill and plankton), then lunges upward through the prey, mouth agape. In this way it fills its gullet with herring and seawater. The gullet becomes greatly distended, expanding along the longitudinal pleats in the whale's ventral surface. The whale's mouth closes tightly, and then, with its huge tongue, it forces seawater out through its mesh of baleen while retaining the herring.

A variation is the "horizontal lunge," in which the whale pursues its food across the surface of the water. Horizontal lunges are made with the whale in virtually any orientation. At times the whale is on its side, often with one flipper out of the water, the lateral surfaces of both upper and lower jaw exposed. At other times its dorsal surface and upper jaw are exposed in a posture reminiscent of a crocodile on the rampage. Or the whale may be completely overturned, its pleated ventral surface and cavernous lower jaw protruding from the sea. Between the vertical and horizontal lunges there is a full range of possible angles in relationship to the sea's surface.

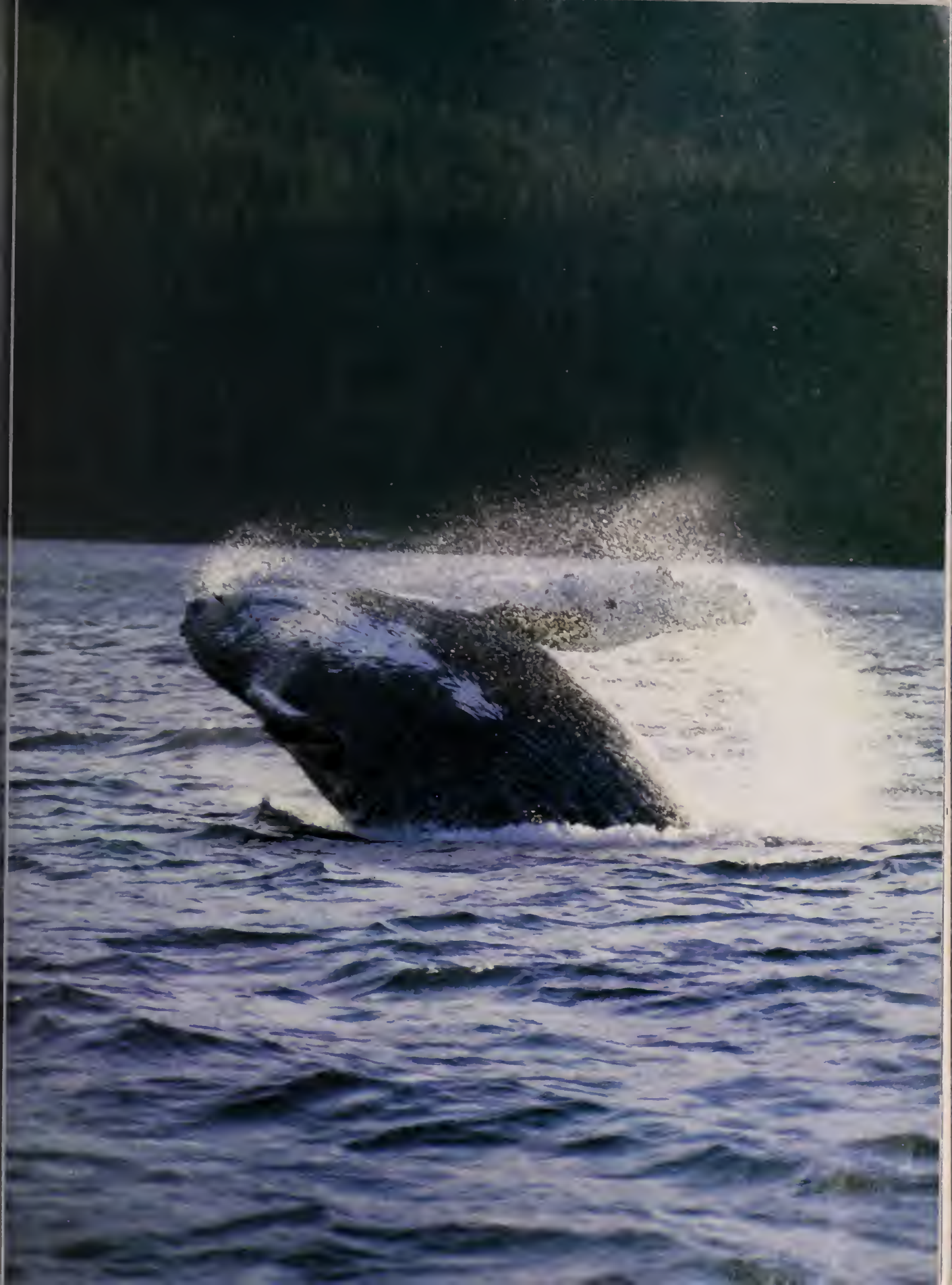
Lunge feeding in a single whale is dramatic enough, but when six or seven of these huge mammals lunge in a coordinated effort, the effect is stunning. Such group feeding seems more common than lunge feeding by individual whales, and we rarely saw fewer than three participate in a lunge. The maximum number we observed was seven.

When such a group of whales feed together, it is not a loose association. Often the whales seem to be actually touching each other, so tightly are they grouped. The entire variety of lunge patterns was regularly observed in a single group lunge. Lateral, ventral, and dorsal surfaces of horizontally lunging whales, interspersed by one or two whales clearing the surface in vertical lunges, were a common sight. To see seven whales (weighing a total of perhaps 250 tons) erupt within a fifty- or seventy-foot circle, their lunges timed within a second or two, is awesome. Even more to the point, it suggests a respectable ability to communicate and coordinate actions.

Almost as fascinating are the ways humpbacks prepare for feeding. Or, to be more objective, how they increase concentrations of the prey before expending energy lunging. Bubble-net feeding is the most sophisticated method humpbacks employ to optimize food concentrations. One or two whales swim upward from below the prey in a closing spiral, blowing a constant stream of bubbles. The bubbles rise faster than the whales and form an ever narrower net around the trapped fish. The herring, following their instinct to flee from anything flashing in the water, swim away from the bubbles and gather at the center of the bubble-net. The whales then lunge upward, filling their gullets with seawater and herring. It has been reported that whales may vary the size of the bubbles in the net to suit the type of prey—small bubbles for tiny fish and large ones for larger fish such as herring. Bubble-net feeding has also been reported with plankton and other passively drifting prey.

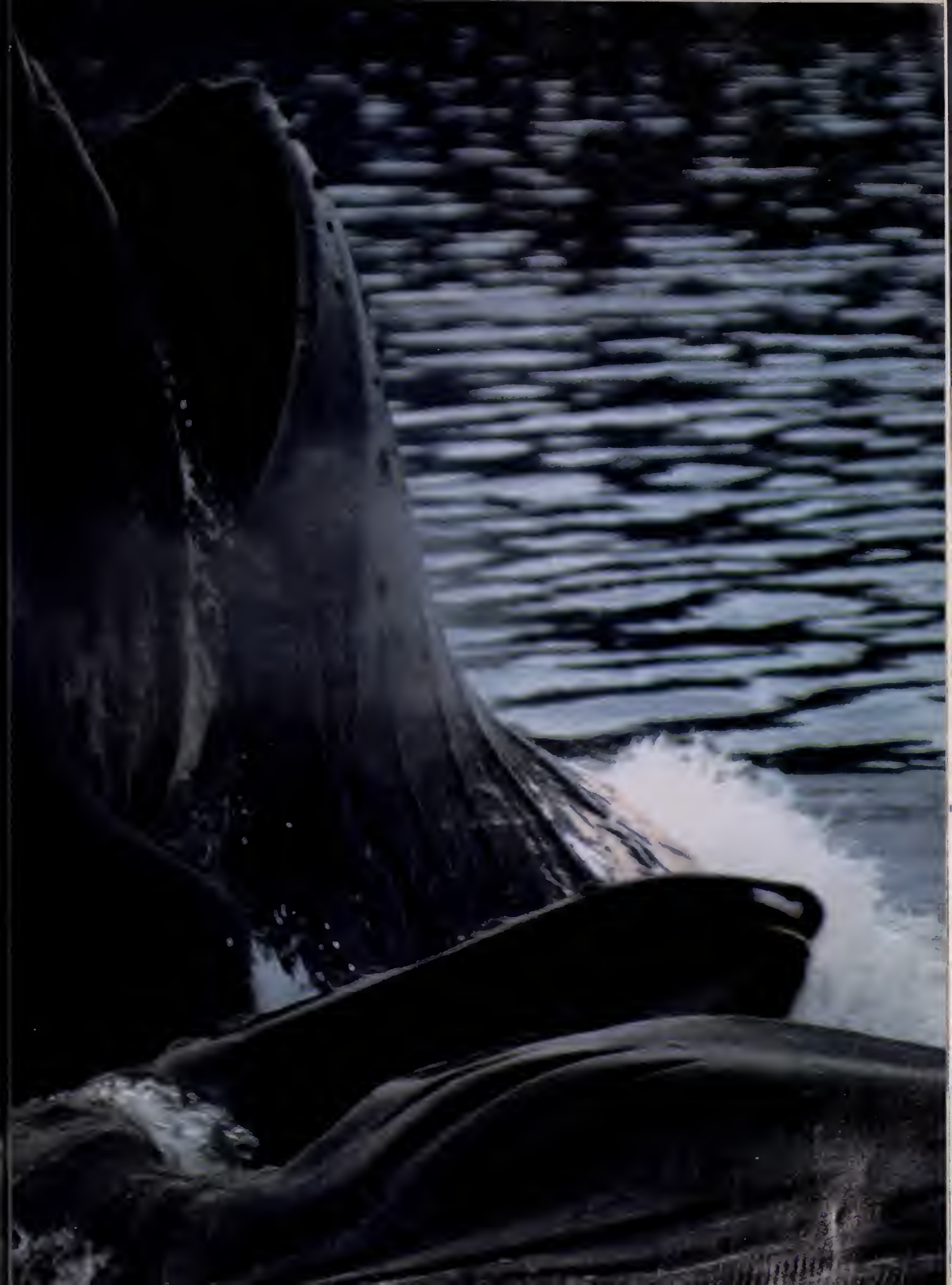
No visible behavior of the whales can match the bubble-net for subtlety. On

A humpback whale breaches the water off Admiralty Island, Alaska.





Groups of four to six humpbacks commonly lunge-feed together, showing exquisite timing and coordination. In one instance, seven whales erupted from the water within a seventy-foot circle, their lunges coming no more than two seconds apart.

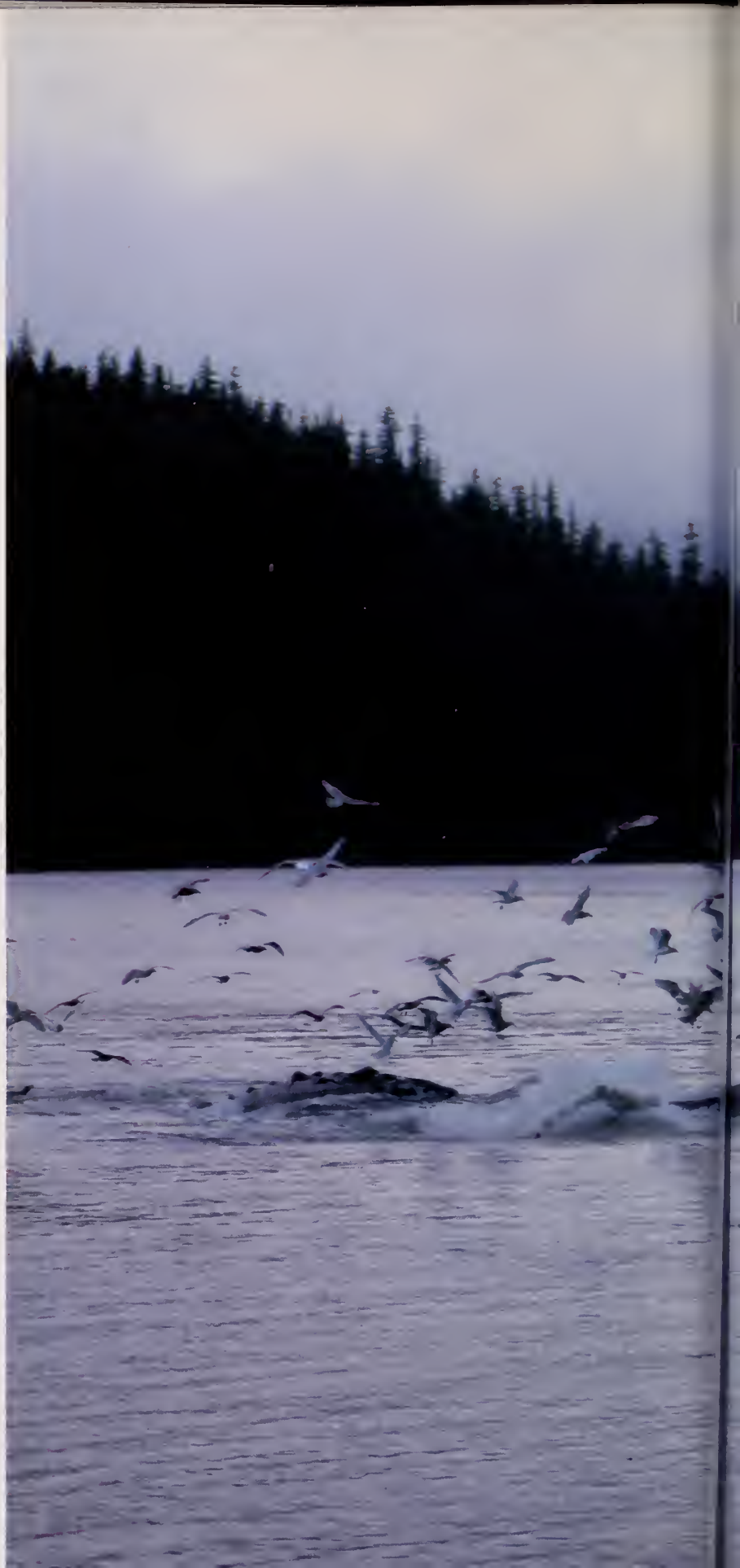


the other hand, when the whales elect to use brawn rather than brain, some interesting things happen. Breaching, lob tailing, and other surface behaviors are occasionally used as herding methods. A whale engaged in lob tailing raises its flukes and a portion of the rear end of its body clear of the water, then forcefully slaps the flukes down on the surface. This is sometimes done with a direct up and down motion of the flukes. At other times, it involves a tremendous diagonal sweep with the flukes and resembles nothing so much as a whale turning cartwheels. In either case, lob tailing results in a tremendous splash and, if you happen to be a herring swimming in the vicinity, a stunning concussion. Thus lob tailing may serve both to stun nearby herring, allowing leisurely feeding, and possibly to drive or herd herring.

Both lob tailing and breaching are performed at times by individual whales, and on some occasions certainly serve purposes unrelated to feeding. We saw instances of a humpback lob tailing on the fringes of a group of whales engaged in feeding. It may have been that the lob tailing (or breaching) whale was coordinating its efforts with those of the other whales, assisting by pushing food toward the pod. Such whales are helping to set the table if you will permit such an image. Once the table is set, the humpbacks are noisy and enthusiastic eaters; one constantly catches glimpses of herring streaming down chins.

Our observations of humpbacks feeding in Alaska during the late fall and winter months raise more questions than they answer. Which whales are wintering-over in the north? Are they sexually immature whales? Or old whales? Or are they cows with calves? And why do they stay? Do they need more food? Can't they make the long journey south with their peers? And is it the same group that stays each year or a different one?

By spending large portions of their own winters watching the humpbacks in remote and rainy regions of Alaska, whale researchers are looking for answers to these questions. □



When a group of humpbacks feed on fish, vertical and horizontal lunges can be seen simultaneously. Seagulls circle overhead, for dead and injured fish offer easy pickings for these scavengers.



Seduction on the Wing

Male thynnine wasps have been known to carry off a female, copulate with her in flight, then drop her

by John Alcock

Among insects, parental behavior is fairly widespread and sometimes highly sophisticated. But the active parent is almost always the mother. An explanation of why, in general, male insects provide their mates only with their sperm can be gleaned from evolutionary theory. Evolution occurs when individuals differ in how many of their genes they are able to pass on to the next generation. If there is variation in the behavior of males in a species, with some males offering assistance to their mates and others providing sperm only, logic dictates that the number of genes contributed by the two types will determine which behavior spreads through a population over time and which will disappear. There is good reason to believe that, under most conditions, males that provide their mates with nothing more than sperm and attempt to copulate as frequently as possible will outreproduce those that allocate some of their limited time and energy to help one or more of their female partners.

To understand why this is the case, consider that males produce smaller gametes than females: sperm are much smaller than eggs. A male usually is able to manufacture so many sperm that he could theoretically fertilize a large proportion of the eggs produced by all accessible females. The male that copulates with a large number of females will have great genetic influence on the next generation, and so the potential evolutionary pay-off of a "Casanova strategy" is extremely large. In contrast, a male that invests in mate-helping behavior must divert energies that could go toward finding and copulating with additional females. The helpful male limits his opportunities to pass on his genes to the progeny of the relatively few females he can assist.

Yet there are male insects that do provide useful services or materials to their partners, as in the case of male giant waterbugs that carry the eggs of their mates on their backs until the young hatch. In other species, males provide food that is used to feed their offspring. Among the dung beetles there



While copulating, a male thynnine wasp (left) gathers nectar from a flowering eucalyptus. The wingless female will soon receive a nuptial gift of the nectar. By feeding his mate, the male may help to insure that it is his sperm that will fertilize her eggs.

A.G. Wells



A.G. Wells





Right: This female has emerged from her burrow in the ground, climbed a piece of vegetation, and is calling for a male by releasing into the air a sex pheromone unique to her species. Far right: Diverse methods of feeding females are used by the male wasps. In this species, the male regurgitates a drop of nectar on a leaf and the female, in copulo, *twists her body underneath the male to imbibe the food.*

are species in which a male may help his partner dig a burrow nest and provision the brood cells with choice dung balls on which the female lays her eggs. In still other insects, males collect food that their mates consume. For example, in certain empidid flies and the unrelated hanging flies, the male captures an insect prey, kills it, and then offers the food to a female as a nuptial gift that she consumes during copulation.

This type of behavior poses an evolutionary puzzle: Why are these males able to transmit more of their genes than would potential competitors using all their time and energy to reach a larger number of receptive females? Randy Thornhill of the University of New Mexico has provided a plausible explanation for the genetic success of helpful male hanging flies. He has found that females that do not receive a nuptial present simply refuse to copulate. Moreover, if the male offers a gift that is not sufficiently large, the female will terminate the copulation prematurely and seek out another male. Once the female has fed to satiation on a large nuptial gift and copulated with the male that presented it, however, she becomes unreceptive for a time to further matings with other males. During that interval, she lays a series of eggs fertilized by her recent mate's sperm. The male's gift to the female therefore advances his own genetic success.

A similar explanation may apply to the evolution of the male mating behavior displayed by some thynnine wasps of Australia. There are well over 500 species of these wasps in Australia, many of them undescribed and most of them unstudied. Judging from the results of the few behavioral studies conducted thus far, however, some features of their biology may be widespread among the group. To begin, the females of these supposedly primitive wasps are wingless, a trait that is related to their method of molelike burrowing through moist soil in woodlands and meadows in search of beetle larvae. When a tunneling female encounters an appropriate victim, she stings and paralyzes the larva, lays an egg on the prey, and excavates a small chamber around it. The egg she leaves behind hatches into a grub that consumes the beetle larva and eventually metamorphoses into an adult wasp.

In a number of species, after a newly adult female emerges from her pupal case she burrows to the surface and crawls up a grass stem or weed. When she has reached a point well above the ground, she adopts the calling posture standard for her species. In many cases this involves perching head-up, with the head held out from the stem. But in other species, the female turns to face down the stem or twig. And in still others, the female holds her abdomen stiffly out at an angle from the perch. In all species studied to date, the female releases a sex pheromone while in the calling position.

Male thynnine wasps possess wings, and often their major activity is to fly about in areas in which females are calling. In my studies of several species in eastern Australia, I captured and then marked males with dots of paint on the back of the thorax. After releasing the marked wasps, I later attempted to net patrolling males in the same area. Individuals were regularly caught as much as two weeks after they had been marked, indicating that the males had home ranges in which they searched day after day for mates.

When a male detects the pheromone of a female, he zigzags upwind toward her. (Although females of several species may release pheromones in the same area, they only attract males of their own kind, presumably because each species produces a unique sex pheromone.) When a male reaches the grass blade or plant stem on which the female is perching, he frantically half-scrambles, half-flies through the foliage in an effort to reach the female before his competitors can find her. The male that makes first contact almost always wins the female, quickly picking her up and carrying her off *in copulo* in a nuptial flight. In some thynnine species, the male transports the female some distance from the call-

John Alcock



ing perch (and away from other males that will fight for possession of a mate) to the relative tranquillity of a nearby resting spot where copulation commences.

Mating patterns of this sort are common among insects, with females calling males to them and accepting the first male of their species to reach them. But what occurs in the thynnine wasps is unique among the Hymenoptera (the wasps, bees, and ants) and unusual among insects generally. Male thynnine wasps often provide their mates with food, offering nuptial gifts analogous to the prey presents given by male hanging flies to females. Unlike hanging flies, these wasps are not predatory but instead feed on the nectar of flowers or the sugary excreta of plant-feeding bugs. Hence their nuptial feeding behavior is somewhat different from that of the hanging flies.

In some thynnine species males merely transport their mates to a source of food; while the male walks forward drinking nectar, the female, linked in copulation, trails behind, also feeding. But in other species, the male's role in feeding his mate is more pronounced. A common pattern is for the male to carry the female, which usually assumes a coiled position at the tip of the male's abdomen (the better to be carried in flight), to a source of nectar. There, the female remains coiled in a ball, head tucked under the male's abdomen, while the male moves energetically from flower to flower or sugar droplet to sugar droplet, collecting liquid food and storing it in his crop. At intervals of several minutes, the male stops foraging and in some way signals to the female; she extends her body and he regurgitates a droplet of fluid to offer to her.

Just as species differ in the coiled carrying position adopted by the female, there are also consistent species-specific patterns of food exchange among thynnines. In some, the male holds the droplet of food in his mouth and the female stretches forward and consumes it. In others, the male deposits a droplet of food on a leaf or branch and the female uncoils, drinks the fluid from the leaf, and then resumes the carrying position. The male laps up any liquid left behind.

There are thynnines in which the male does not offer the female many small regurgitated meals, but instead feeds himself extensively prior to searching for a mate and then offers the female a single large meal during copu-

John Alcock



Right: Males of this species, while copulating, fly from flower to flower collecting nectar. Every few minutes, the female in a mating pair will twist around and drink directly from the male's mouthparts. Far right: These thynnine wasps spend the night in pairs on the plants from which they gather nectar. In the morning the males resume feeding their attached mates. The females' coiled carrying position is typical of their species.

lation. In a species found in southern Australia, the male, after achieving copulation, excretes from the tip of his abdomen a large drop of viscous fluid that the female imbibes while coiled in a U position beneath his abdomen.

All thynnine males expend considerable effort, either before acquiring a mate or during copulation, to secure food for the female. Collecting nectar consumes time and energy that cannot be allocated to the search for additional mates and thus reduces the number of females a male can find in his lifetime. How is male reproductive success advanced by the expenditure of effort to gather nuptial gifts? Because females are wingless, they are probably unable to collect food as efficiently as a male. By providing a nuptial gift for a female, a male saves her the expense of gathering nectar, enabling her to spend more time and energy searching for a beetle larva on which to lay her egg. Moreover, the helpful male provides his mate with nutrients that may contribute directly or indirectly to egg development. Therefore, if the gift-giving male's sperm are used to fertilize the female's egg, he is investing in the propagation of his genes when he feeds her.

Indications are that females that have been adequately fed will not mate again for some time. After nuptial feeding, the pair flies to a spot likely to contain larval prey. As they circle low over the ground, the female disengages from the male and falls to the earth. She remains immobile for a minute or two and then springs to life, scuttling across the ground for a short distance before burrowing into the soil, often at the base of a weed or grass clump. Australian entomologist T.J. Ridsdill Smith found in his study of *Hemithynnus hyalinatus* that females remain underground for about a week, reemerging to call again for another male, another meal, and another copulation. Presumably, if the female had succeeded in finding a beetle larva during her week in the earth, the larva would carry an egg fertilized by the sperm of her most recent partner. Perhaps if females do not receive sufficient nutrients to sustain them for some time underground, they will resume calling at once when released by a male, attract another partner, and receive sperm from him that might supplant those donated by the inferior gift giver. (Geoffrey Parker of the University of Liverpool has found that in insects whose females engage in multiple matings, the last male to copulate before egg laying usually has a reproductive advantage.)

I performed many simple experiments in which I captured and separated mating pairs of several species that had not completed their period of nuptial feeding. Although this must have been a somewhat traumatic experience for the wasps—rough handling was often necessary to get them to disengage—in most cases the female resumed calling almost at once, sometimes even before she had been removed from the insect net in which the pair had been captured. It was not unusual to have several males buzzing frantically about the net a minute or two after a copulating pair had been separated. These experiments indicate that females do have the potential to mate more than once in a short period. Hence a gift-giving male does gain an advantage by feeding his mate adequately, thereby encouraging her to go underground to search for beetle larvae after mating with him rather than remaining above ground and soliciting another mating and more food.

Thus females that are able to mate multiply and displace old sperm with each copulation can actually make it advantageous for a male to provide a food gift for them. When nuptial presents originate, the trait will spread because the sperm of males that do not feed mates will tend to be superseded by the sperm of gift-giving males. Male wasps provide the present because it is in their own genetic interests to do so, but in one sense they have been manipulated by the mating behavior of females. If egg fertilization becomes contingent upon receipt of an acceptable meal, only males that offer food will receive a genetic return from copulating.

Given the advantages to female hanging flies and thynnine wasps in receiving assistance from their mates, one wonders why other female insects have not evolved traits that make helpful actions the adaptive option for males. Perhaps they have. For a growing number of species, ranging from houseflies to butterflies, it is now known that males transfer materials along with the sperm during copulation and that the quantity of these substances determines how long the female waits before she copulates again and receives a competitor's sperm. In some cases it has been established that the extra materials are metabolized by the female and used to produce her eggs. Thus males of many insects may be forced to offer nuptial presents in one form or another if they are to fertilize the eggs of their mates. □





Flower & immature seed cone

Protean Beauty

An artist's sampling captures the varied beauty in a diverse family of plants

Illustrations and text by Willard K. Martin

Proteus, prophetic old man of the sea in Greek mythology, had the power to change his shape at will, an ability he used to avoid capture by those trying to make him divulge his knowledge. Among plants, the family Proteaceae is an aptly named group of diverse plants whose often showy inflorescences and seed capsules come in a rich variety of forms and colors.

The flamboyance of many Proteaceae flower clusters is due largely to long, colorful bracts, modified leaflike structures. Members of this family typically grow in parts of the world that have a long dry season every year, and their bracts and other leaves tend to be covered with hairlike outgrowths and protected by a thick cuticle that reduces the water lost in transpiration.

Proteaceae characteristically bear clusters of individually small flowers, which may be pollinated by insects, birds, mice, or small marsupials. Some of these are strikingly large clusters. South Africa's king protea (*Protea cynaroides*), a member of one of the family's largest genera, may reach nearly a foot in diameter, and the erect flower cone of Australia's yellow bull banksia (*Banksia grandis*) can include as many as one thousand tiny flowers in a spike up to a foot and a half tall. Other species of various sizes and shapes resemble pincushions, thistles, or asters.

The genus *Banksia*, or Australian

Banksia baxteri

As the many small flowers of the Banksia baxteri *inflorescence drop off, they leave behind a woody seed cone. The cone contains many ovaries, but only a few develop seed capsules. These capsules mature into beautifully colored protuberances covered with delicate white and golden hairs.*



Winged seed

ripe seed cone

honeysuckles, was named after the British naturalist, explorer, and patron of science Sir Joseph Banks, who accompanied Capt. James Cook on his 1768–71 expedition to Australia. In 1770, when Cook discovered the inlet just south of present-day Sydney, he named it Stingray Harbour. Later, the harbor was renamed Botany Bay in recognition of the many plants Banks found in the area. In addition to the Australian honeysuckles, he discovered giant figs, palms, tree ferns, the flame tree (*Brachychiton acerifolium*), and the crimson-flowered waratah (*Telopea speciossima*).

Banksias are among the most diverse members of the family, ranging from prostrate shrubs, with inflorescenses that seem to lie on the ground, to trees that grow up to fifty feet high. Pollinated primarily by honey eaters, all Australian honeysuckles produce copious nectar, and many are valuable sources of honey. Australian aborigines make a honey drink by soaking the dense flower spikes in water, and in many areas of the countryside, children often collect the nectar by banging the flower heads against a dish.

In suitable habitats, within the plants' natural range and outside it, Proteaceae are frequently cultivated in public and private gardens. In Hawaii, outstanding specimens of these plants are grown at the agricultural experimental stations on the islands of Maui and Oahu. The macadamia nut tree (*Macadamia ternifolia*), a Proteaceae native to Australia, is an important commercial crop in Hawaii. Many varieties of Proteaceae are now grown commercially in California, mostly from seeds and rooted cuttings imported from New Zealand and South Africa. The colorfulness of the bracts enhances their appeal and their stiffness lengthens the life of cut flower heads; dried, the heads and bracts are often sold as centerpieces for arrangements.

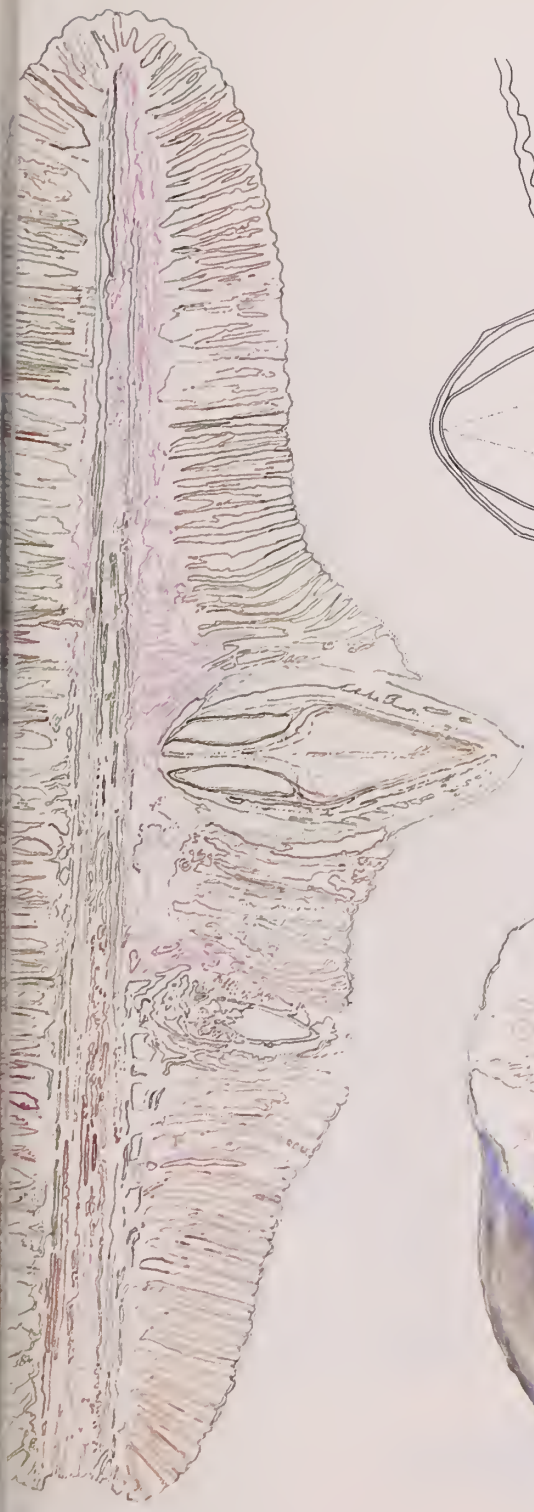
Dead or alive, wild or cultivated, these beautiful and variously shaped members of the family Proteaceae will captivate all who see them as surely as the family's namesake tried to avoid capture.

Developing seed capsules expand greatly on the seed cone of Banksia menziesii. *At maturity, the capsule, or nodule, pops open, releasing two winged seeds.*



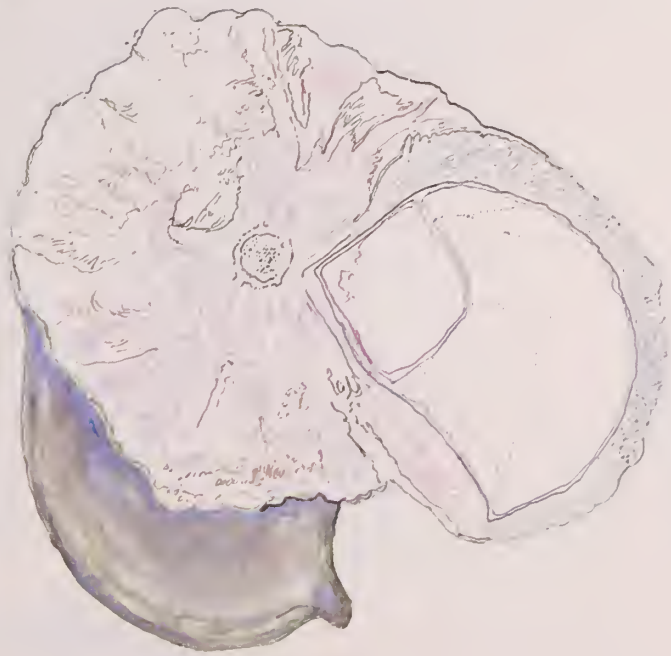
Flower and maiure seed cone

Banksia menziesii





Seed Nodule, open for seed release



Seed cone (Vertical section)

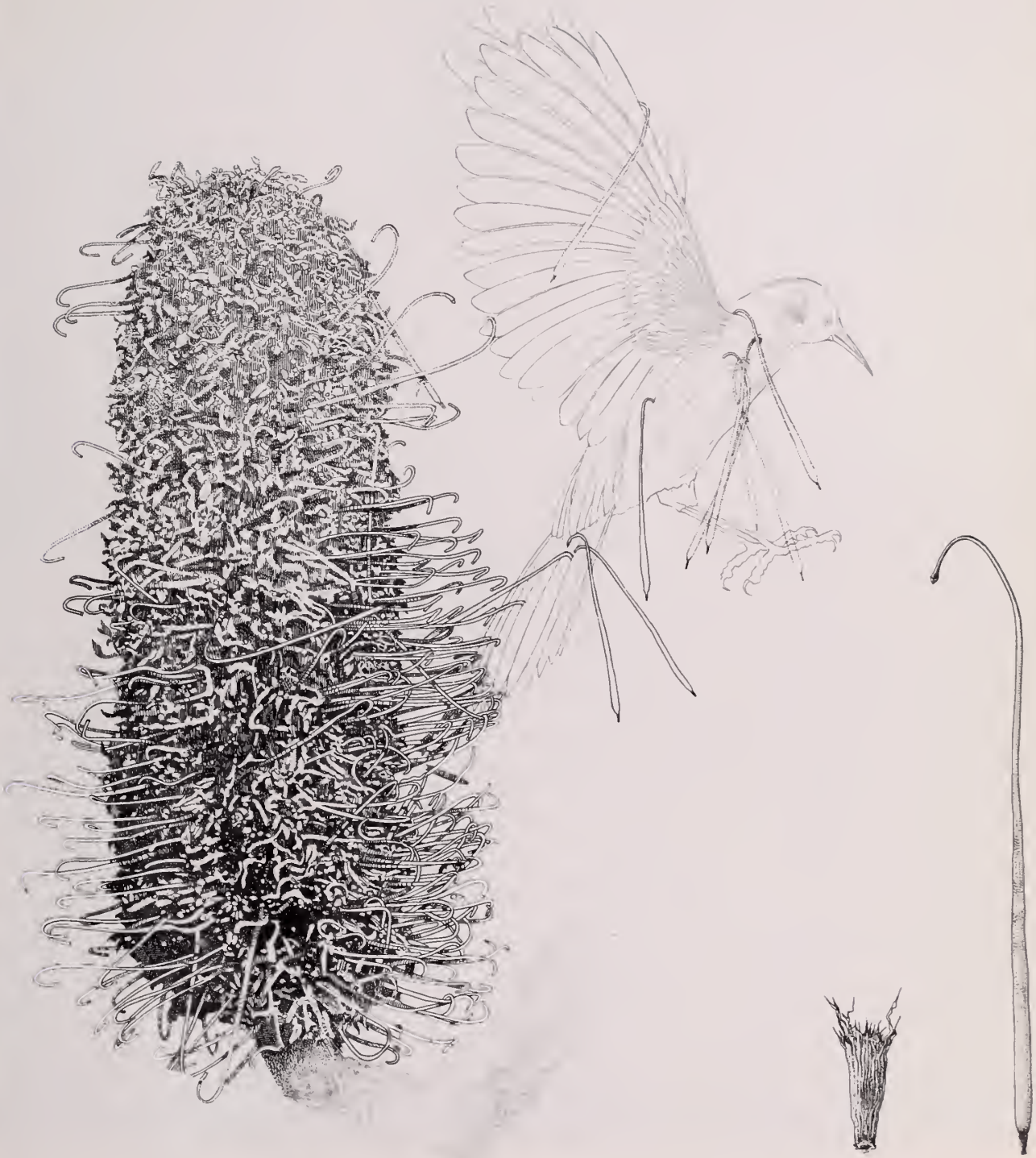
Seed cone (Horizontal section)

The colorful Banksia *flower heads attract birds, which pollinate the flowers as they search for nectar at the base of the style. It has been suggested that some birds may also disperse the seeds of* Banksia collina, *as shown but recent studies indicate that is unlikely.*



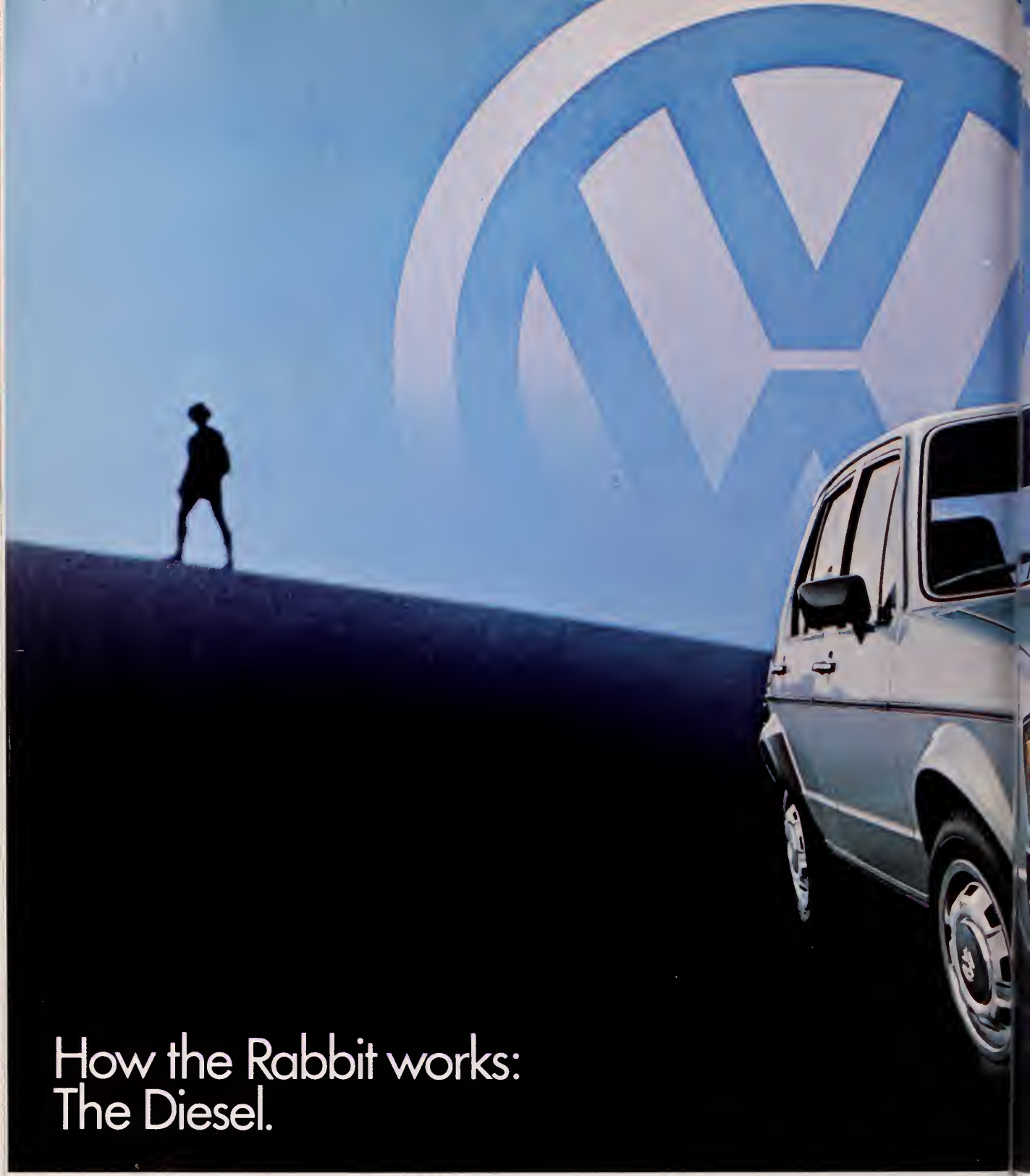
Flower spike

Banksia collina



Seed spike

Seed & carrier



How the Rabbit works: The Diesel.

Oil is a natural liquid energy-storage system. It is produced by burying undecomposed organic matter under hundreds of tons of pressure for 200 million years. Prudence dictates that we use it sparingly.

Which is the fundamental advantage of Dr. Rudolph Diesel's compression ignition engine. Speed and power are controlled directly by restricting the fuel supply.

The engine can have all the air it wants, but only enough fuel to accomplish the job at hand. At idle, that can be as low as 4 tablespoons an hour. Although very efficient, it is also very slow and heavy, unfortunately placing it at odds with the concept of the small passenger car.



Nothing else is a Volkswagen.

To address these disadvantages, VW introduced the lightest 4-cylinder Diesel ever produced. A wider power band and substantially improved performance were provided by a new swirl-chamber, aluminum cylinder head. Fuel economy remained phenomenal.

There are several Diesels on the market, and if all you want is to be prudent, they all should be of passing interest. If you're interested in passing too, there is only one choice.

The Rabbit Diesel. Also known as the best mileage car in America.*

*EPA estimated 45 mpg 58 highway estimate. (Use "Estimated mpg" for comparisons. Your mileage may vary with weather, speed, and trip length. Actual highway mileage will probably be less.)





Survival in Space

Extreme cold is only one of the hazards for astronauts who venture outside a spacecraft

by Bruce Webbon

Unprotected in the vacuum of space, a human being would survive for only a few minutes before swelling up (because water vaporized inside the skin would not be able to escape as fast as it vaporizes) and becoming freeze-dried. Accordingly, without artificial life-support and protective systems that emulate the earth's environment, manned space flight would not be possible.

Humans evolved in an atmosphere composed primarily of oxygen and nitrogen at a pressure of approximately fifteen pounds per square inch. Although it may often seem very hot or very cold, the earth's atmosphere provides a relatively benign temperature environment within an average range of about ± 100 degrees Fahrenheit. It seldom gets colder on Earth than −80° or hotter than 130°. By contrast, space lacks a true atmosphere and the temperature range may go from −460°, an approximation of absolute zero, to 300° or higher.

The main requirements for survival in space are oxygen at an appropriate pressure, supplies of food and water, and systems to control the humidity, insure a comfortable temperature range, remove carbon dioxide and other gases, such as sulfur dioxide, and handle our solid and liquid wastes. Designing equipment to satisfy these requirements within the smallest spaceship of all—the spacesuit—is especially difficult.

The fundamental purpose of the spacesuit is to establish around the astronaut's body an artificial atmosphere containing oxygen. To maintain life and to saturate the blood with oxygen, the oxygen pressure in that atmosphere must be greater than approximately 2.5 pounds per square inch but there is no need to have a maximum pressure higher than our normal one. The spacesuit must also protect the astronaut from other hazards, such as bombardment by micrometeoroids. Because the intensity of sunlight is much greater above the shield of the earth's atmosphere, the side of the suit facing the sun may get very hot, while the other side, exposed to deep space, may get very cold. The suit must therefore be insulated to protect the astronaut from these temperature extremes. The earth's atmosphere also guards us from some of the high-energy radiation in space; the spacesuit must accordingly provide some degree of radiation protection.

Today's spacesuits evolved from the high-altitude flight suits designed in the 1930s and 1940s to protect airplane pilots and balloonists. Those suits, in turn, were originally derived from deep-sea diving suits. The first experimental high-altitude suits were developed in the early 1930s by Mark Ridge, an American aerial stunt man, in conjunction with the British physiologist J.B.S. Haldane. Known for his research on the physiological effects of deep-sea diving, Haldane worked with Ridge to develop a suit that would protect high-altitude balloon pilots. In 1933 Ridge tested the suit in an altitude chamber at a simulated altitude of 90,000 feet—approximately a mid-stratospheric height. At 90,000 feet the air is very thin, so this suit is considered to be the world's first spacesuit. But Ridge's dream of using it to fly in a high-altitude balloon never materialized, and the suit was never used again.

Wiley Post, a well-known test pilot and aviation daredevil, also dreamed of setting a high-altitude record in his Lockheed monoplane, the *Winnie Mae*. Post worked with engineers from the B.F. Goodrich Company to develop the suit that he used for a series of high-altitude flights in 1934 and 1935. But Post never got the opportunity of using his suit to set an official high-altitude record; on a flight with the American humorist Will Rogers, in August 1935, the plane crashed, killing them both.

Data provided by these early, pioneer-

Astronaut Edwin E. ("Buzz") Aldrin, Jr., dressed for a walk on the moon. The photograph was taken during the Apollo II *mission in 1969 by Neil A. Armstrong, the first person to step on the moon.*

NASA

ing modifications of deep-sea divers' suits were used by World War II designers to develop suits that would protect the crewmen flying at high altitudes in unpressurized planes. Above about 30,000 feet, a protective suit is necessary. The development of pressurized suits for use in high-altitude military aircraft continued throughout the 1950s. With the elimination of pressure points (places where the suits rub against the body), the suits became more comfortable and mobile enough to permit the operation of aircraft controls.

In 1958 the newly formed National Aeronautics and Space Administration (NASA) initiated Project Mercury, whose goal was to put manned space capsules into orbit around the earth. To attain this objective, suits and life-support systems had to be developed that could be used for many hours at altitudes of more than 100 miles.

The requirements for the Mercury spacesuit were similar to those for high-altitude military aircraft. The suit served as a backup to the space capsule's pressurization system. It had to be comfortable when worn unpressurized for hours on end, but it did not have to provide much mobility because the Mercury astronauts remained seated in the capsule at all times. Since the suit was not meant to be used outside the capsule, it did not have to protect the astronauts from temperature extremes and the other hazards of space.

The Project Mercury spacesuit was, in fact, two suits—one inside of, and attached to, another. The inner suit was made of rubber, and its purpose was to contain the gas—pure oxygen in this case—used to pressurize the suit, exactly as gas is contained within a balloon. Rubber, however, is highly elastic and, like a balloon, the inner suit expanded if it wasn't restrained. That was the function of the outer suit, which was made of a heavy, synthetic canvaslike fabric and resembled a workman's coveralls.

The astronaut entered the spacesuit through a zippered opening. A helmet and gloves were then mechanically attached. A hose connected to the capsule's life-support system supplied the astronaut with oxygen for breathing, and a second hose removed his expired carbon dioxide from the suit. The carbon dioxide was extracted and the purified gas was then recirculated. Any protective suit will interfere to some degree with the mobility of the wearer. But the astronauts of Project Mercury and the early Gemini missions—our second manned space project—did not leave their capsules. Their suits were designed for use exclusively within a severely limited area and therefore did not need to be very flexible.

NASA



Space suit, above, was designed in the early 1930s for American aviation daredevil Wiley Post. Contemporary prototype units, right, are the result of half a century of evolution.

The first American to venture outside a space capsule was astronaut Edward White during the flight of *Gemini IV* in June, 1965. This first so-called extravehicular activity, or EVA, was simply an experiment to demonstrate that astronauts can survive in space when given the proper protective equipment. White was connected to the Gemini capsule by an "umbilical cord" that supplied oxygen and communication lines. Problems that arose during White's and succeeding Gemini EVAs indicated that more sophisticated suits and life-support systems would be needed if astronauts were to perform useful work in space.

When these early-model suits were pressurized, moving about in them required a great deal of physical effort. This not only tired the astronauts but also caused them to become overheated. There are two main reasons why extraordinary effort was required to move around in those suits. First was friction created between moving parts. Every time an elbow or knee was flexed, the rubberized inner suit rubbed against the

Anthony Wolff





outer restraining fabric suit. Second, just like an inflated balloon, a pressurized spacesuit is forced by the pressure of the gas within it into an inflated and stiffened position. When an astronaut moves in a suit in that condition, the gas inside the suit is slightly compressed, but the energy to compress the gas is supplied by the astronaut.

A spacesuit easier to move around in and a portable life-support system that would allow the astronauts to be independent of their space capsules were clearly needed for the Apollo moon landing program of the late 1960s. The purpose of the Apollo mission was to explore the lunar surface, set up and perform a variety of scientific experiments, make geologic observations, and collect lunar samples. The Apollo spacesuits had to shield the astronauts from the hazards of the lunar environment and provide the necessary life-support systems for periods of up to eight hours during which the astronauts would be walking on the moon.

Most people have seen pictures of white-suited astronauts on the lunar surface. Very few people, however, have ever seen an actual Apollo spacesuit. The familiar white suit is only an insulated outside cover made of canvaslike material, worn over multiple layers of thin plastic film coated with an aluminum spray. The surface of the moon can get as hot as 250°to 300°F where it is exposed to the sun. The shaded areas, on the other hand, can get as cold as −250°. Because the moon has almost no atmosphere to filter out incoming solar radiation, the astronaut is also baked by direct rays from the sun. The white outer suit was designed to insulate and protect the astronaut from these extreme temperatures, but unfortunately, at the same time, it seals in the heat produced by the astronaut's body.

Nylon mesh garment worn under modern spacesuits is equipped with soft plastic tubes that carry cooling water. Below, a model already wearing the lower section of a suit crouches to get into the upper section.



Anthony Wolff

All living creatures generate heat as a result of the metabolic processes that maintain life. A resting human adult produces about as much heat as a 100-watt light bulb. When working hard, the same individual can easily generate ten times as much heat energy. The human body has built-in temperature regulation systems that maintain safe body temperatures of about 97° to 102° during normal activities on the earth. Skin temperature is controlled by blood flow to the skin and sweat rate. Body heat is carried away primarily by the circulation of the air around us and by the evaporation of sweat. But an astronaut enclosed in a pressure suit and an insulated protective suit must be cooled by other means.

Relatively little attention was given to cooling during the Mercury and Gemini programs. The Gemini suit incorporated a system of ventilation ducts that was intended to cool the astronauts by blowing oxygen from the capsule over their bodies. Experience showed that this system was inadequate to cool someone who was working hard while wearing a pressure suit. Therefore a liquid-water cooling system was developed for the Apollo program. The Apollo astronauts wore a liquid cooling garment (LCG) under their spacesuits and next to their skin. The LCG looks like a suit of long underwear with a network of fine, flexible tubing attached to it. Body heat was removed by cool water pumped through the tubes. In addition, the Apollo suits had urine containment and transfer systems, and the astronauts wore a diaper-like garment under the LCG, just in case. These cooling and elimination processes were found effective and they are still in use in the suits designed for the space shuttle.

A backpack first introduced in the Apollo program was a key protective element. All of the life-support systems carried by the astronaut were in this

backpack. Oxygen for breathing on EVAs was in a pressurized tank in the pack. The oxygen was metered into the suit by a regulator that also controlled the suit pressure. The oxygen was circulated by a small fan driven by an electric motor. Gas leaving the suit contained the carbon dioxide exhaled by the astronaut, as well as evaporated sweat and trace gases, such as sulfur dioxide and hydrogen sulfide, produced by the astronaut. The trace gases were absorbed in the backpack by a filter bed made of activated charcoal. The sweat was condensed by a device, called a cooling heat exchanger, that cooled and dehumidified the gas before it was recirculated back into the suit. The carbon dioxide was removed by a chemical, lithium hydroxide. The gaseous carbon dioxide reacted with the hydroxide to form a salt, lithium carbonate. This reaction removed the carbon dioxide as fast as it was produced and the suit gas, enriched by oxygen from the storage tank, was sent back into the helmet through a duct.

The LCG water that had been warmed by the astronaut's body heat was pumped into a cooling device in the backpack called a sublimator. Water from a separate storage tank in the pack was also fed into the sublimator, where it was evaporated by exposing it to the vacuum of space. This evaporation process removed heat from the LCG water so that the cooled water could be recirculated. The water vapor from the sublimator was simply vented overboard. On the earth, this Apollo backpack weighs about 130 pounds, but on the moon it weighs only about one-sixth as much.

The Apollo program demonstrated that space-suited astronauts can work routinely outside their spacecraft. The Skylab program, which followed in the early 1970s, demonstrated the usefulness of EVAs. Skylab's EVAs were quite different from the tasks of lunar surface exploration done during Apollo. The primary reason for the Skylab's EVAs, planned prior to the launch of that spacecraft, was to periodically change film canisters in cameras mounted outside the cabin as part of earth resources and astronomy experiments. The astronauts worked near the capsule airlock so that a life-support system could be maintained through an "umbilical" hose and an autonomous backpack was not necessary. The Skylab spacesuit assembly was essentially the same as that of the Apollo system.

During the unmanned launch of the Skylab laboratory, one of the solar panels was damaged and failed to deploy in orbit. Part of the cabin's exterior insulation was also damaged so that the cabin became very hot. If these problems had not been solved, the entire Skylab program would probably have been canceled. The only solution was to have suited astronauts launched in another spacecraft manually perform the repairs outside the Skylab craft. The problems were compounded because those repairs required the astronauts to work 100 miles up in space on capsule areas where no handrails or tether attachment points had been installed. Handrails are needed for safe movement between the airlock and the work site, where a tether could be attached to hold the astronaut in position while working. The first Skylab crew nevertheless successfully made the needed repairs.

During the period between the end of the Skylab program in the early 1970s and the first shuttle flight in 1981, a new spacesuit was developed. For one thing, women were admitted into the space program as astronauts beginning in 1977. To no one's surprise, they needed smaller suits than those worn by the male astronauts. From the initial Mercury program through the Skylab program, all the spacesuits had been custom tailored to fit individual astronauts. But beginning with the space shuttle in 1981, the suits have been made in separate units of different but standard sizes and were assembled for the astronauts more or less "off the rack." The new spacesuit when assembled is similar to the Skylab suit, except for the torso, which is now made of fiberglass instead of rubber and fabric. The life-support systems in the backpack are permanently attached to the hard fiberglass torso, rather than being removable, as in Apollo. This change improved the reliability of the systems and simplified the hours-long checkout procedures required before an EVA. The shuttle suit operates with an internal gas pressure of approximately one-fourth of an atmosphere—the same pressure as that of earlier suits. The life-support system is functionally identical to that of the Apollo system, although considerable redesigning was required to integrate the systems with the hard torso.

The shuttle spacesuit and life-support system will be used for the first few years of the shuttle program to allow the astronauts to perform a wide range of EVA tasks. Many satellites, such as the large space telescope, are being designed for maintenance and repair by suited crewmen. This is simpler and cheaper than trying to accomplish the same job with a robot. Nevertheless, automated systems are needed for other jobs, such as maneuvering large payloads in the shuttle's cargo bay, and for assembling large space structures.

The current space shuttle EVA system has many shortcomings that preclude its use for routine space construction operations. About two pounds of



Early mission suits, shown here, were custom tailored for individual astronauts. Today's suits come in standard small, medium, and large size units that are then assembled to give a "custom" fit.

John Grossman

cooling water and lithium hydroxide are used up by the shuttle backpack during each hour of operation in space. Since these expended materials must be resupplied from the earth, many thousands of pounds would be required to support large construction crews working in space. To resupply the cooling water and lithium hydroxide required for expendable systems is too expensive; therefore, cooling and carbon dioxide control systems that can be regenerated for reuse must be developed.

The spacesuit for this "blue collar" EVA system must be durable and reliable enough for months of daily use with only routine maintenance. It must also operate with an internal pressure higher than one-fourth of an atmosphere—on the order of one-half of an atmosphere or more. This is needed to avoid the potential danger of decompression sickness, or "the bends," when the astronauts decompress from the pressure of one atmosphere in the shuttle or space station cabin to the lower suit pressure. This is exactly the same bends problem that deep-sea divers may encounter when ascending after a dive. In both cases, the problem occurs when the ambient pressure around the body is reduced after a period in which the body's tissues and fluids have become saturated with nitrogen and the body is in equilibrium with its surroundings. The pressure reduction takes place at the end of an extended deep dive and requires decompression stops on the way to the surface. It occurs at the beginning of an EVA. The bends are avoided when using the shuttle suit by having the astronaut breathe pure oxygen for three hours prior to an EVA. This period of wasted time would be intolerable for routine EVA operations.

As already mentioned, the suit, which now comes in separate pieces, can be assembled according to the requirements of a particular mission. The basic torso with integral, regenerative life-support systems could have lightweight fabric arms and legs attached when it is to be used in low Earth orbit and arms and legs with additional shielding as protection from radiation when used at higher altitudes. This shielding could easily be provided by making the suit extremities and the torso out of the same material, probably a metal such as aluminum.

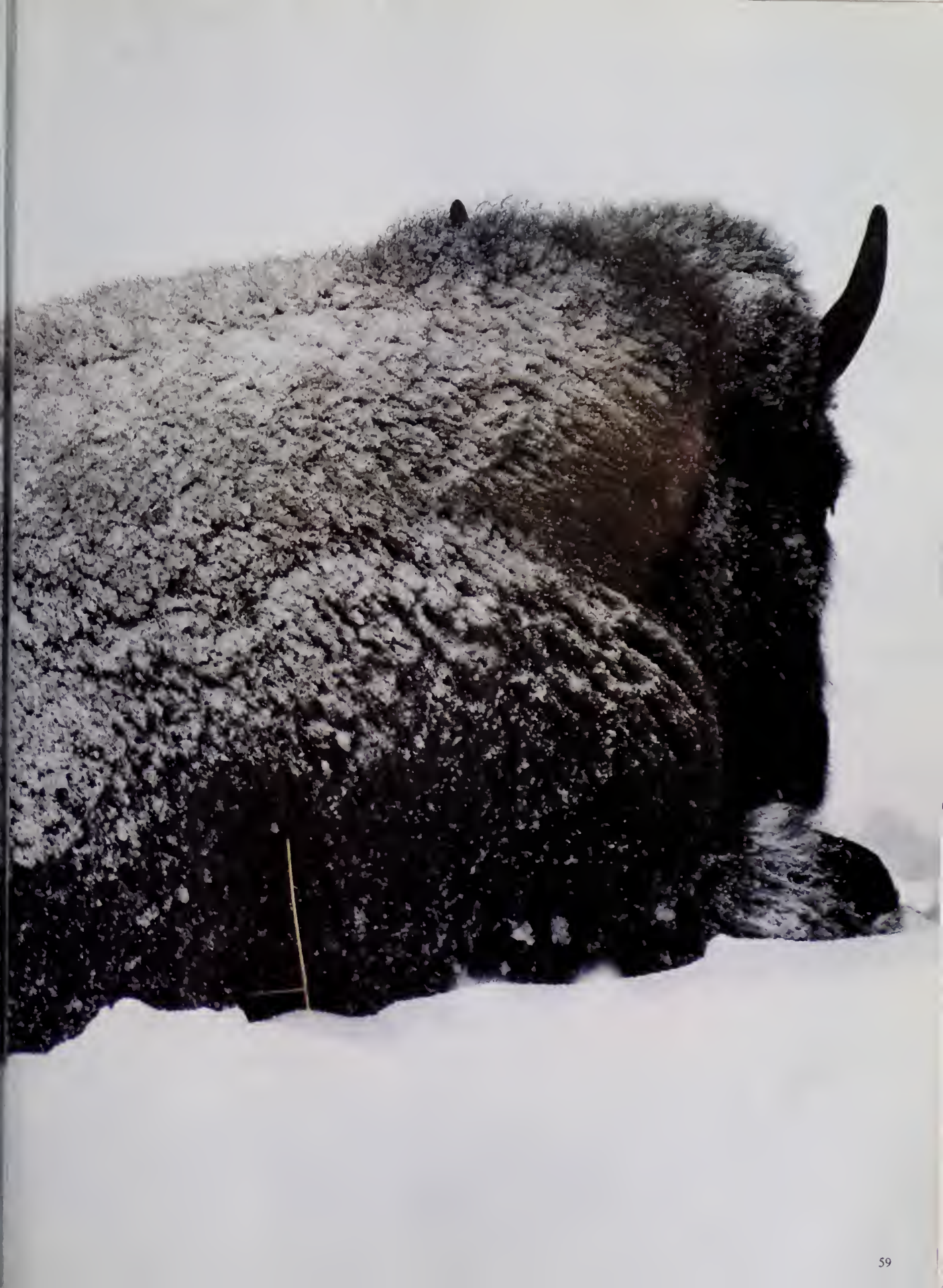
Many future space missions have been suggested. Before they become reality, however, new portable life-support systems must be developed. □



Yellowstone Buffalo Winter

Photographs by Jeff Foott

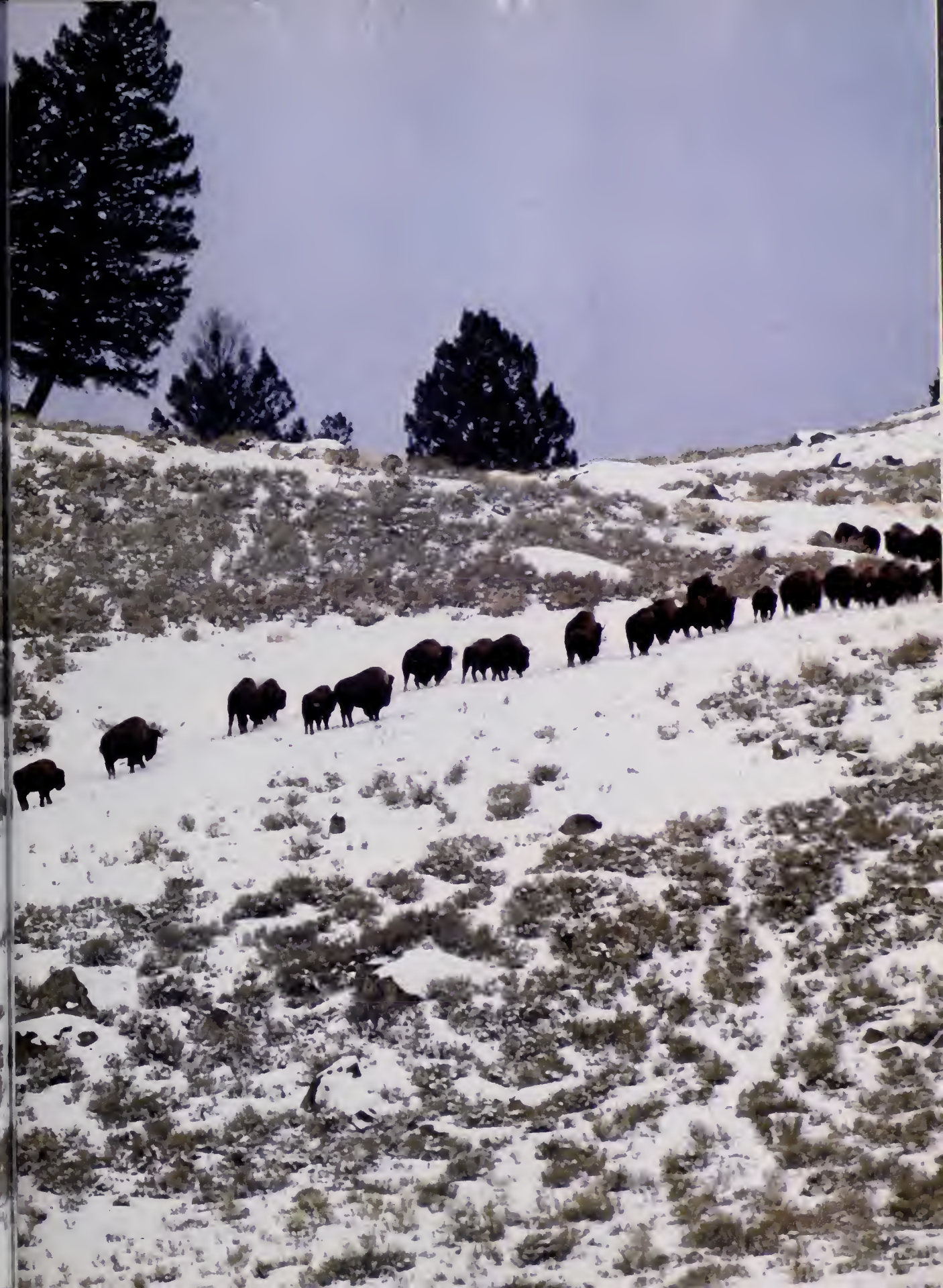






Snow. In Yellowstone National Park, the accumulated flakes of winter precipitation exert a strong influence on the movements of the buffalo herds. Mixed herds, bull groups, and solitary bulls are increasingly confined to wintering valleys as the snow deepens. The animals can scrape away the snow to depths of at least three feet to get at the forage beneath. Relatively secure in the valleys, they pass the winter rummaging through the snow, obtaining enough food to carry them over to spring.

There are winters, however, when some buffalo don't survive. Normally, buffalo can plow through heavy snow, doing so when they move to another valley after having exhausted the forage in one area. Mixed herds can be seen traveling in line, plunging trenches in the snow. But the snow sometimes proves impassable. When this happens, buffalo mortality rises as the food supply of the trapped animals runs out. The severe winter of 1964–65 saw snows that blocked a group of buffalo in a slough in the Bechler Meadows. Eighteen of the animals starved to death.





Llama Caravans of the Andes

For centuries, llama trade caravans have provided the principal link between pastoralists of the Andean highlands and agriculturists who inhabit the valleys

by Terry L. West

From Lake Titicaca in Bolivia, the Desaguadero River meanders southward for 200 miles to Lake Poopó. Off the southern edge of this lake, at an altitude of some 12,000 feet, lies the canton of Pampa Aullagas. The 3,000 Aymara-speaking inhabitants of this cold and arid plateau region subsist on a combination of pastoralism and agriculture, raising sheep and llamas for meat and wool and cultivating potatoes and quinoa, a native cereal. Because frost and drought endanger even these high-altitude crops, which are the dietary staples of the area, the people of Pampa Aullagas depend on exchange with people living at lower altitudes, where agriculture is less precarious. Like pastoralists throughout the Andean highlands, they not only have the motive to engage in trade but also possess the means—



Loren McIntyre; CHER

On a ten-day journey from the Peruvian highlands, a llama caravan carries potatoes to Arequipa to be traded for lowland produce.

animals that can transport the products that come from the various levels of this "vertical environment." Llamas, in addition to serving as a source of animal products and as local beasts of burden, have for centuries been assembled into caravans for this long-distance trade. More sure-footed on the rugged terrain than the burros (and horses) imported by the Spaniards, the native llamas are also cheaper to maintain. They can forage along the route for their food, while burros, the usual beasts of burden in nonpastoral areas, require fodder that has to be grown or purchased.

As accustomed as they may be to physical discomfort, the Aymara find journeying with llamas an extraordinary hardship. "To travel with llamas is to suffer," is the refrain of those familiar with the experience. In recent years, as the people of Pampa Aullagas have found alternative means of obtaining valley products, they have tended to abandon the arduous task of conducting llama caravans. Many drovers have so depleted their stock of male llamas by butchering them for market that they lack sufficient numbers to outfit future expeditions. When llama caravans were the rule rather than the exception, however, they helped occupy the dead time between the May harvest and the September planting. In years of poor harvest and famine, entire families embarked on such caravans in the search for food.

Because of a severe drought, the harvest of 1977 was a dismal one, giving me the opportunity to take part in a llama caravan that under other circumstances would probably not have been organized. The instigator was fifty-year-old Sergio, who was accompanied by his new son-in-law, Hilario, age twenty-seven. Hilario confided to me that at that time of the year he normally would be in the Department of Santa Cruz working as a migrant laborer, but he was going along out of obligation to his new father-in-law. The rather domineering Sergio had also succeeded in getting Hilario to convince his own father to join them. Four years older than Sergio,

Thomas Hollyman, Photo Researchers



Llamas are useful as beasts of burden on both long- and short-distance trips. Above: Llamas near Lake Titicaca transport goods to market. Right: Individual ownership is indicated by the notches in a llama's ears.

Gregorio had last gone on a caravan in 1974. Because of his age he had not anticipated going on any more, and he had gradually sold off the thirty mature pack llamas he had used on his last caravan, butchering them for the meat market.

Before we began to load for our departure, which took place May 17, there was a brief farewell ceremony. Sergio's aged mother provided a tin incense holder, and Hilario's older brother and wife supplied alcohol. Everyone present sat or squatted in a semicircle, exchanged coca leaves for ritual chewing, and drank sugar cane alcohol. By turns, the three drovers bared their heads and knelt in prayer. Holding the burning incense tray aloft, each beseeched the earth spirits for a safe and successful trip. Then we loaded our cargoes and set out on our journey.

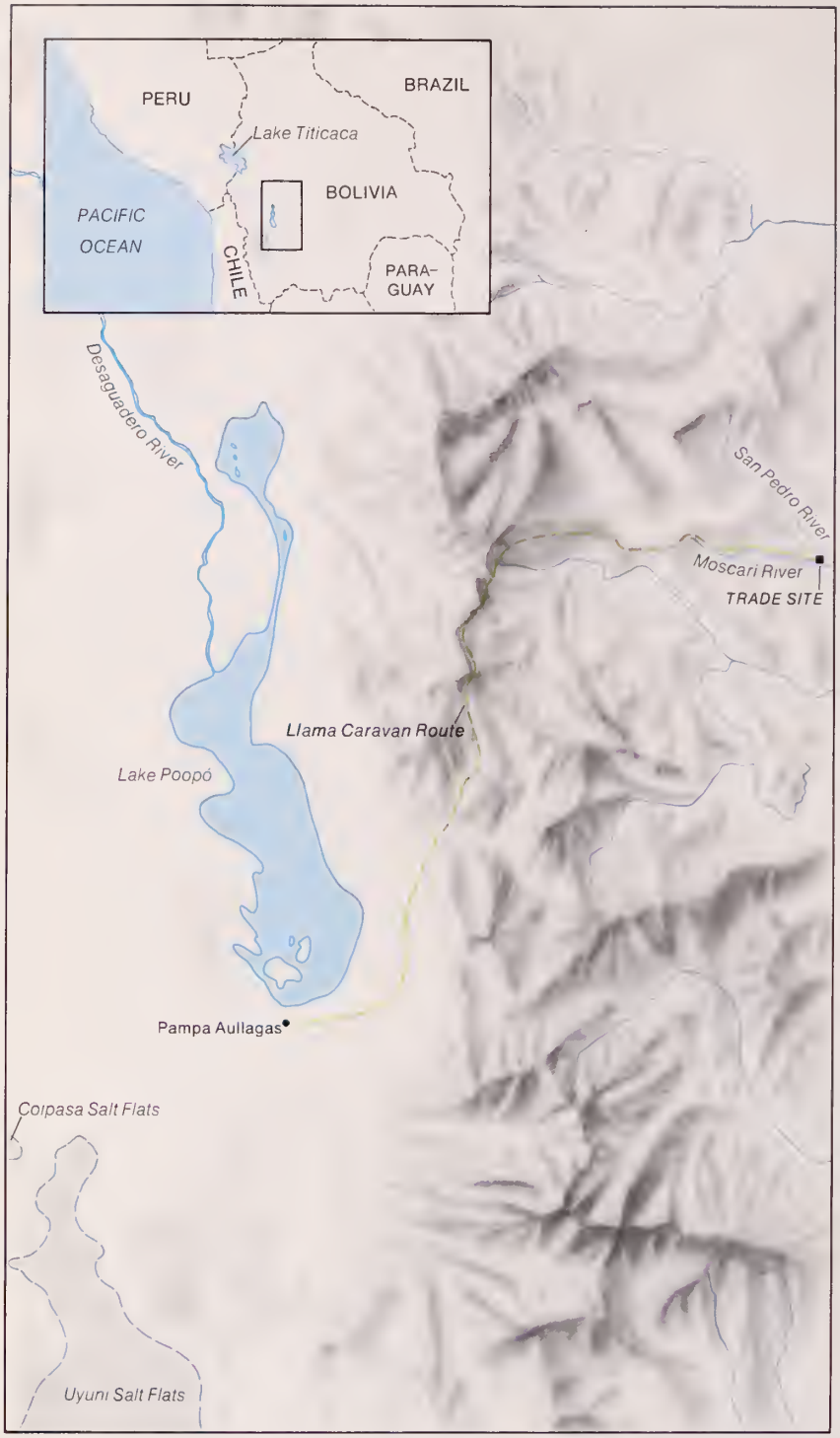
Llama caravans from Pampa Aullagas may be termed salt caravans because salt is the bulk of the cargo the Aymara inhabitants take to trade. In the past, drovers made a one-week trek with their llamas to the salt flats of Uyuni, sixty miles to the south. There they purchased salt from the local residents, pausing a week before making the return trip. Now, most acquire the salt from truckers who transport it to Pampa Aullagas for sale. Then, following the harvest, troops of cargo-laden llamas and their drovers depart Pampa Aullagas on a three-month trade circuit to valleys in the east, where the salt is exchanged for the products of the local Quechua-speaking agriculturists. These include wood, medicinal herbs, and above all, foodstuffs, among which maize ranks first, both for domestic and ceremonial consumption. Until the last few years, no major ritual ceremony in Pampa Aullagas was complete without the serving of corn dishes and maize beer, and even now, guests who enter the houses of local authorities on special occasions are expected to genuflect before a wall altar containing ears of corn. Drovers on caravans will kiss the first few ears of maize they receive en route in exchange for a handful of salt. They also recite prayers to the *tunari*, or "valley," where maize is grown.

On the basis of precedent, drovers from Pampa Aullagas visit specific valley destinations so that both men and cargo are dispersed equitably throughout trade areas. This enables drovers to estimate the quantity of salt they need to take and the amount of maize they will receive. It also assures long-term relations with specific *caseros*, or "trade partners." Since the Aymara drovers and their Quechua clients share neither ethnic, kinship, nor communal ties, the establishment of binding *casero* agreements represents the main link between two otherwise distrustful populations. The potential theft of cargo or animals worries drovers, whereas valley residents are concerned about crop damage from strayed llamas. If drovers have been known to cheat on measurements, valley people have been known to receive cargoes on trust and disappear without reciprocating. Establishment of *casero* ties—and concomitant personal ones—mitigates this mutual distrust. To further cement their bond, *caseros* exchange gifts and services and, in some cases, sanctify their ties through the

Alan Becker, Photo Researchers



Andrew Tomko



Despite the growth of commercialism and motor transport, traditional llama caravans are still to be found in Andean South America. While in Bolivia in 1977, the author accompanied one such caravan from Pampa Aullagas (elevation more than 12,000 feet) into the eastern chain of the Andes and down to a valley trading site. The llama drovers took salt obtained from the Uyuni salt flats near Pampa Aullagas to trade for corn and other valley products that cannot be grown in the high-altitude environment.

institution of *compadrazgo*, the relationship of co-parenthood that is established between parents and godparents.

Drovers learn routes and acquire *caseros* by accompanying their fathers, uncles, older brothers, or other men as helpers. As one drover explained, "When one serves as a helper, you are introduced to people. The next year, when you return to the area, you have your clients. When you travel with your father, you make *caseros* with the sons of his *caseros*."

Most of the veteran drovers that I met began their apprenticeship as helpers to their fathers at age six to eight. A helper is usually a man's son or nephew but can be a daughter or niece if a male helper is not available. Also, young men whose own fathers lack llamas may volunteer to assist drovers to whom they are unrelated. In this way, they obtain maize for their parents, plus experience for their own eventual caravans. The standard compensation for such helpers in Pampa Aullagas in the 1970s was the free use of five of the employer's llamas for the transport of the helper's own trade goods.

Helpers are expected to perform irksome, low-prestige chores, such as fetching water and gathering dung for fuel. On our 1977 expedition, Hilario served as helper mainly to his father, while I acted as Sergio's helper. The caravan contained a total of fifty-five llamas, of which twenty-eight belonged to Gregorio and his family and twenty-seven to Sergio. There were also three burros to carry utensils and provisions and to serve as pack animals once we reached our destination. Each drover was responsible for looking after his own animals and conducting his own trading, although on the march the animals intermingled freely, with one man walking behind them and one on each side of the caravan.

Only male llamas are used as pack animals, and they are usually castrated because the drovers believe that this makes them more resistant to fatigue. Caravan llamas range in age from three to seven, with ages four to six regarded as the best. Whenever possible, caravan veterans are selected as lead animals. The average mature male llama can carry a load of about seventy-five pounds, with some capable of sustaining a hundred pounds over short distances. To avoid unduly fatiguing their llamas, most drovers limit their cargo weight to between fifty and sixty pounds.

The salt we transported came in both solid blocks and granulated chunks. The

NOW WE KNOW WHAT IT'S LIKE TO BE ALONE.

It wasn't always this way.

It used to be hard to decide among all the 35mm SLR's.

Then we created the new Minolta XG-M. A camera so extraordinary it stands alone in its class. With an unrivaled combination of creative features.

First, it's automatic. So it's easy to get sharp, clear pictures. You just point, focus, and shoot. It even has electronic features that keep you from making mistakes.

As your skills advance, you'll appreciate advanced features like metered manual and exposure override for full creative control.

To further separate ourselves from the competition, we built in the option of professional motor-drive. Something normally found only on more expensive cameras.

It lets you shoot a blazing 3.5 frames per second. So you can catch a baseball as it comes off the bat. Or halt a horse leaping a hurdle.

But to fully grasp the XG-M's advanced design, you have to hold it.

The body feels rugged yet light. With a built-in textured grip that's sculpted to fit snugly in your hand. And oversized controls that make it easy to adjust to changing conditions.

As your creative potential develops, you'll have access to over 45 interchangeable, computer-designed Minolta lenses. As well as the Minolta system of SLR accessories.



All in all, the XG-M is a remarkable achievement. But then, we have over 50 years of remarkable achievements to draw on.

The new Minolta XG-M. Now we know how it feels to be alone.

But we're not complaining.

WAIT 'TIL YOU SEE HOW GOOD YOU CAN BE.

MINOLTA

For more information, write Minolta Corporation, 101 Williams Drive, Ramsey, N.J. 07446.
Or see your Minolta dealer. In Canada: Minolta Ontario, L4W 1A4.

Product appearance and/or specifications are subject to change without notice.
©1981 Minolta Corporation

If you have a special little niece, a grandson or other favorite child



Give the gift that turns on a child's mind.

The name of this unique gift is HIGHLIGHTS FOR CHILDREN. It is the most honored, and possibly the most beloved, monthly children's magazine in the world. And, in a day and age when fads in toys and trinkets and clothes appear and vanish almost before you turn around, HIGHLIGHTS FOR CHILDREN could be one of the most exciting Christmas presents you will ever give.

For HIGHLIGHTS is not only different from the usual gift, it is different from other children's magazines as well. Its intent is not only to delight and entertain, but to challenge and teach. The editors are nationally known experts in child psychology and family life; they firmly believe that growing children find their greatest pleasure in thinking and creating.

Throughout the year, HIGHLIGHTS FOR CHILDREN brings its young subscribers good fiction and poetry; authoritative articles on science, music, math, nature, space and famous people; craft projects; puzzles, games and just plain fun. It avoids any suggestion of violence or crime in words or pictures. Each issue is 42 or more pages long, bound in sturdy tagboard. The type is large and easy-to-read. There are no coloring or cut-out pages, for HIGHLIGHTS is meant to become part of each young subscriber's permanent library.

HIGHLIGHTS appeals to a wide age range: from tots of 2 who love to listen to its stories and do the simple preparation-for-reading exercises within its pages . . . to 12-year-olds who find the biographies and science articles prime sources for school reports. HIGHLIGHTS helps children develop positive habits that will benefit them as long as they live. The fun-with-a-purpose concept helps children experience success—at home and in school.

For a relatively small price, HIGHLIGHTS brings your love and remembrance to children you treasure . . . not just at Christmas, but all through the year. The contribution HIGHLIGHTS FOR CHILDREN can make to a child's development, however, as it reinforces reading as a pathway to pleasure and information, is a gift that will last a lifetime.

1 year $13.95 (Postage & handling: Canada, $2.50/year; other foreign $3/year.) Gift rate valid to 12/25/81.

Please send HIGHLIGHTS as my gift to:

child name(s) and age(s)

address *apt. no.*

city *state* *zip*

Sign gift card "From _____"

11 • NSZN

your name

your address *apt. no.*

your city *state* *zip*

$ _____ enclosed ☐ Bill me (no need to pay till Jan. 1)

Satisfaction guaranteed or money refunded.

Highlights® for Children
2300 W. 5th Ave., P.O. 269
Columbus, Ohio 43216

•• BE-A 01 • NDZ

latter are carried in llama-hair bags, which weigh about fifty pounds when half full. The bag is draped across the back of the llama, with the salt separated into two equal compartments and tied on with an eight-foot length of thick, braided llama-hair rope. Salt blocks, purchased in pairs, are wrapped in coarse straw (to protect the llama's back) and linked together with strands of llama-hair rope. Draped over the llama and tied on by ropes, two blocks are designated "one cargo" of salt, equivalent to a bag. We took fewer cargoes than animals to allow younger, weaker llamas a respite. Each morning we took care to leave unloaded the half dozen llamas that had been particularly fatigued the previous day, rotating their loads to stronger animals.

A typical day's travel for us averaged six hours, beginning at about 9:30 A.M. and ending at 3:30 P.M., in time for the llamas to graze. Once on the move, we seldom stopped to rest until camp was made. Veteran drovers attempt to pace their daily march so as to reach familiar campsites each afternoon. In addition to pasture, access to water holes and firewood is an important consideration. Only occasionally are there stone corrals in which to herd the animals at night. The lack of corrals complicated our daily chore of loading and unloading the cargoes.

Although a relative of the camel, the shorter llama is always loaded when standing. Only semidomesticated, llamas are not reared from birth to be pack animals. Our llamas were not trained to harness and only partially trained to voice commands, and we had to start, stop, and guide them by flailing a short length of rope, whistling, and making body blocks. The first few days of the journey were a constant battle to prevent the escape of llamas to their home territory, and throughout the trek we were kept constantly busy herding grazing strays back into the main mass of the caravan. Novice pack animals had to be load broken by tying light bundles, such as ponchos or blankets, on their backs.

Our principal morning chore, done right after breakfast, was to load the animals for the day. This we accomplished by a hectic but well-established routine. First, we herded the animals into a compact mass close to the stacked cargoes. A number of pack ropes were then tied together to form one long rope, which was laid on the ground in the form of a large U. Once the animals were herded into this U, the ends of the rope were quickly raised off the ground,

BOOK HUNTING?

Virtually any book located—no matter how old or long out-of-print. Fiction, nonfiction. All authors, subjects. Name the book—we'll find it! (Title alone is sufficient.) Inquire, please. Write: Dept. 71

BOOKS-ON-FILE P.O. BOX 195 UNION CITY, NEW JERSEY 07087



THE ETRUSCANS CAME FROM TROY.

Here's yet another (and intriguingly documented) theory about the origins of the Etruscans. Read about it, and other thought provoking findings, in ART AND ARCHAEOLOGY NEWSLETTER, illustrated, now in its 15th year. Gift card on request. Free Etruscan reprint when you send $7.00 for a 4-issue subscription to Reiss Editors, 243 East 39 Street, NYC 10016

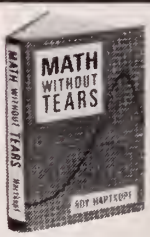
Javanese Shadow Puppet Prints



from the Javanese shadow play. Posters are 20" x 26" and are beautifully reproduced in black on white. Excellent for framing, an interesting gift! $10.00 ppd

Shadow Graphics
Post Box 327-B / Putney, VT 05346

MATH WITHOUT TEARS



Using non-technical language and a light touch Roy Hartkopf gives you a basic understanding of many everyday applications of mathematics. He takes the reader from simple counting to trigonometry and calculus, emphasizing the practical aspects of math. Humorously written.

Learn math in the comfort of your own home at minimum cost.

Order Now: $10.95 plus $1.25 hdlg
EMERSON BOOKS, INC.
Dept. 138-G, Verplanck, NY 10596
10 Day Money Back Guarantee



Treasures From The Earth

Color Portfolio of Natural Specimens and Catalog of Minerals, Display Stands, Books and Natural Jewelry, $3.00

Dover Scientific
Box 6011C Long Island City, NY 11106

Each year, since 1972, we introduce at least one exciting new travel program; and for the summer of 1982 we offer our first tour into the most ruggedly beautiful, untamed region of Europe:

Adventure in Montenegro

JULY 2 TO 17, 1982

Here, in the dramatic Dinaric Alps of Yugoslavia, our small and expertly led group will spend five nights under canvas and descend the Tara River by log rafts as it flows through pine forests and the huge Dumitor National Park.

Before the thrilling river journey we enjoy five days in historic Dubrovnik and the spectacular Dalmatian coast and visit Montenegro's ancient capital of Cetinje.

Detailed brochure available from:

HANNS EBENSTEN TRAVEL, INC
705 WASHINGTON STREET, NEW YORK, NY 10014
TELEPHONE (212) 691 7429

pulled together, and tied. This formed a corral around the mid-sections of the bunched llamas; a second rope was then wrapped around the herd at the knee level. While one of us remained on the outside, circling the corral to prevent escapes, the others climbed inside the ropes and, using shorter pack ropes, linked small groups of adjoining animals by binding their necks together. When all the llamas were bound into clusters of four to six, we could remove the outside restraint ropes and begin the loading. Scurrying back and forth between the stacked cargo and the waiting llamas, each drover tied his loads onto the backs of the pack animals with a slipknot. When a cluster had been loaded, the rope binding their necks was released and they were allowed to graze. Lastly, the camp utensils were loaded on the burros, the llamas united, and the caravan set off for the day. The whole procedure usually took us one hour.

Unloading was done in the same manner until the llamas became habituated. Then it could be accomplished without ropes, simply by forming the animals into a mass and darting in and jerking the slipknots loose with one hand while lifting the cargoes off with the other. This technique enabled us to unload in less than twenty minutes. Once unloaded, the scattered packs and tie ropes had to be gathered and arranged. Each drover on a caravan not only recognizes his own animals but can also identify his own cargo bags and ropes. Each man usually tends to his own tasks before helping a fellow drover with his.

Before being stacked, bags were inspected for holes, tears were sewn, the straw that protected the blocks was redistributed, and frayed ropes were replaced. We then stacked the cargo in piles to form a windbreak, and laid out bedding on the sheltered side. This done, one person was sent for water, while another prepared a crude fireplace. Only then would we take a rest break, eating a snack of flour mixed with water and sugar. Immediately afterward, everyone spread out to gather sagebrush or dried dung for the fire.

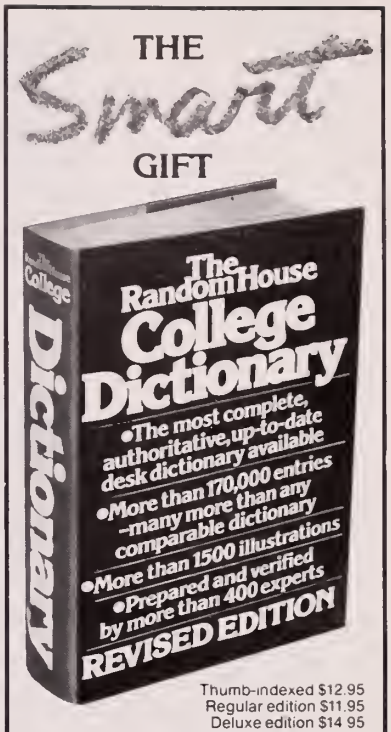
Once the sun went down, the winter chill came rapidly upon us. Huddled around the cook's fire, we would eagerly await our first meal since breakfast. For both meals we had *lahua*, a stew made of flour, lard, water, salt, fresh and freeze-dried potatoes, and an occasional slice of carrot or onion. A piece of dried meat bone would be added to the pot for stock. Gregorio and Sergio took turns cooking. The diet was monotonous, but hunger made us lap up the last drop. Supper over, the voluble Sergio would discourse in Aymara until chill or fatigue drove everyone to bed. Once we had left the plateau and entered the eastern Andean mountains through a series of passes, the extreme cold prevented a sound sleep. Intermittently dozing and conversing, we would pass the night. Everyone slept fully clothed, wearing two pairs of pants and a jacket.

On our route we sometimes followed roads passable by truck and bordered by homesteads and fields. At other times we took shortcuts over wind-swept knolls along trails made by years of human and animal passage. Yet even in the coldest, most barren regions, there were signs of human habitation. We observed circular huts of straw or rock used by isolated herders, tiny potato patches tended by aged men, and women carrying infants on their backs in a blanket tied over the shoulder.

As we wound through trails cut through rock crevices so narrow the packs would scrape on either side, we noticed droplets of blood spattered on the rocks. The blood was from llamas whose feet had been cut on the jagged surfaces. At night we would tackle the animals with the worst wounds and treat them. With me holding the animal on its side, Hilario would urinate into a can and pour the urine into the cuts as disinfectant. Gregorio would then use a knife to pry out chunks of gravel from the moistened wound. Once they were cleaned out, he would squeeze daubs of llama lard into the open cuts. Both men would then work together to slip each claw of the cloven hoof through slits in a four-inch square of llama hide. Thongs were then run through holes punched on each corner and the "sandal" was bound to the animal's foot.

On May 31 we began to enter the valley that was our destination, although the transition was not a clear one. Instead, there was a series of canyons that we had to drop into and then climb out of. Morning might find us in a warm, narrow river canyon where peach trees grew, while in the afternoon, we would be a thousand feet above it on a grassy, wind-swept knoll where only flocks of sheep and llamas grazed. Both men and animals being weary, it was with great relief that we reached the temperate valley floor on June 5. Now it was fleas, not the cold, that plagued us at night.

We camped on the banks of the Moscari River, which we followed downstream toward our destination. On June

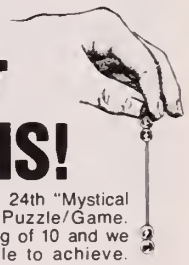


Thumb-indexed $12.95
Regular edition $11.95
Deluxe edition $14.95

Now at your bookstore RANDOM HOUSE

Publishers of *The Random House Dictionary of the English Language, Unabridged Edition*

YOU CAN'T DO THIS!



Pictured above is the 24th "Mystical Effect" of the IBEX Puzzle/Game. It has a difficulty rating of 10 and we admit it is impossible to achieve. But there are 23 other effects with difficulty ratings from 1 to 9 that can drive you sufficiently insane. (The IBEX is the anti-magnetic Puzzle/Game reviewed by Phil Wiswell in the May/June 1981 issue of GAMES MAGAZINE.)

The IBEX Puzzle/Game consists of four non-magnetic steel balls, a non-magnetic steel rod, and a powerful magnet. The IBEX comes in a royal blue pouch and plastic case with a 48-page color booklet revealing its "Secrets".

The object is to cause the non-magnetic balls and rod to hang suspended in a variety of configurations with increasing difficulty ratings. (In one effect, two balls and the rod can remain suspended for months.) Also included are game rules for 1 to 6 players. During play, the IBEX defies gravity in a way that still amazes scientists.

Will you master the IBEX or will the IBEX become your master? Unless you send $9.95 you will never truly know, will you?



Send $9.95 to:

IBEX

International, Inc.
5142 N. St. Louis Ave.
Chicago, IL 60625
(Please add 50c Postage & Handling)



SEMINARS IN ORNITHOLOGY

The Laboratory of Ornithology at Cornell University Offers a Home Study Course in Bird Biology

Inquire: NH, 159 Sapsucker Woods Road, Ithaca, NY 14850



This photograph is the Maya Crystal Skull and is an example of the subjects that you can read about in Popular Archaeology, now in its 10th year of publication. Each issue brings you "The Mystery and Excitement of the Search and Excavation." Edited by professional archaeologists, this magazine is written in an easy-to-read style and is well illustrated. You will receive articles on the pyramids of Egypt, American archaeology, Roman and Greek Archaeology, human evolution, the scientific methods used in archaeology, and notices on opportunities to do field work. Each subscriber also receives our Special Publication series, such as: New England Tomahawks, Hopewell Mounds, SE weeping eye culture, prehistoric Pueblo cultures in the SW. Subscribe to a world of archaeology for less than the regular annual subscription rate, and receive an additional free bonus of good-reading back issues. Subscription is $12.75 for one year, $19.75 for two years, and $24.75 for three years.

Popular ARCHAEOLOGY

P.O. Box 4190, Arlington, VA 22204

Anyone for Tenons?



If your racket is tenons, doubles or singles, and you want a perfect match every time, you can learn from the professionals. They know a classic way to join two pieces of wood together is with a tenon that fits into a mortise.

Fine Woodworking magazine speaks this language to more than 200,000 readers—people seriously interested in making beautiful things out of wood. Whether you are an aspiring novice or an accomplished expert, you'll find it an especially informative magazine, with finely detailed articles about techniques and tools, materials and design. It's written by master craftsmen who share their many years of woodworking experience. And it's printed on heavy paper to withstand years of reference. All back issues are in print and indexed periodically.

If you want to become a better woodworker, send $14.00 for a one-year subscription (6 issues). Or call us toll-free, 1-800-243-7252, to charge your order to Visa or MasterCard (Connecticut residents call 1-426-8171).

Fine WoodWorking®

The Taunton Press
52 Church Hill Rd.
P.O. Box 355CX
Newtown
Connecticut 06470

7 we traveled up a small feeder stream bed and took a narrow, uphill path that led to the hamlet where we would stay and trade. In single file the caravan wound its way up the steep path while we scrambled alongside to fight jams caused by irritated llamas. One would try to crowd ahead of the rest, while another, equally aggressive beast would take offense and begin to spit in the eyes and nip at the neck and ears of the upstart. Until we parted them, the whole trail would be blocked by the combatants. Once, when out of frustration I used blows to separate a group, Sergio chastised me by casually remarking, "Gringo, one must have the patience of Jesus Christ to travel with llamas." Gradually the trail leveled off, and we made camp at dusk, exhausted. The next morning at dawn Sergio discovered that in the darkness he had spread his blankets over an ants' nest.

This hillside was to be our final camp, where the llamas would remain pastured. From then on, one man would stay to guard the camp while the others would visit clients and arrange trades. The burros would be used to transport cargo to and from the houses of the local residents. June 8 was the festival of Corpus Christi, and my companions spent the morning in celebration of our safe arrival.

Sergio and Hilario arose before dawn and went uphill to a rock formation to await the morning sun. There, facing east, they made offerings to the mountain spirits in the morning solitude, burning llama lard, incense, herbs, and coca leaves. On their return they continued their ritual libation of alcohol to the extent that Hilario was sent to buy another bottle. In our journey we had covered some 180 miles in twenty-two days, including seven rest days along the way.

Scattered throughout the canyon we had reached were tiny hamlets, interspersed with farmland and isolated houses wherever the terrain was flat. Thornbush and cactus grew in the dry grasslands that formed the mountainsides, but where there were clearings and water, the soil was rich in vegetation. People were at work in the fields trimming ears of corn off dried stalks or cutting other stalks to dry. Cattle used for plowing were tethered in fields of stubble. Near people's homes were large trees on whose lower forks stalks of maize were stored for fodder. Next to the plots of maize were smaller ones of broad beans, peas, and squash.

Before the development of motor

roads, llama caravans were the only outlet for surplus maize. Valley residents require salt for themselves, their draft animals, and goats. According to the drovers, the valley people are also anxious to trade their yearly surplus because insect larvae infest stored maize and render it fit only to feed to chickens and pigs. In contrast, on the arid plateau, maize, freeze-dried potatoes, and quinoa can be stored for years.

When a caravan arrives, valley people are generally busy with the harvest, and so they expect the drovers to shell their own maize. After the trade has been agreed on, a drover enters his client's patio and is presented with mounds of dried ears to shell. He spreads the ears over a blanket and, with bare feet, treads them vigorously to snap off the dried kernels. If the maize is still wet, then the kernels must be rubbed off by spindling the ears between the palms of the hand. The friction that results causes sores and even bleeding. This and the shrinkage that occurs as the maize dries explain why drovers will delay their departure from the valley until the end of June rather than accept water-soaked maize in trade. While it might seem to be burdensome for drovers to shell their own maize, they have the advantage of choosing the quality of ears to shell.

Those who still travel with llamas are mainly pastoralists who lack money for truck fare or market purchase. The beneficial exchange rate they enjoy also motivates them: "With llamas there is no transportation charge, only physical suffering—work. In the market, when you buy maize you get an exact weight. When we trade, it is done by estimate, and we always get an extra amount."

In remote areas frequented by llama caravans, traditional forms of measurement by volume are still used. At present, salt is traded on a volume-for-volume basis. If the harvest is good, the valley people will be especially generous with their surplus to compensate for the bad years, when they cannot reciprocate adequately for the cargoes of salt. When the maize is plentiful, the llamas return burdened to capacity, and sometimes fatigued llamas weaken and die.

Nineteen seventy-seven, however, was one of the poorer years, and when Sergio, Gregorio, and Hilario set off on July 12 for the return trip to Pampa Aullagas, they were not enthusiastic about the results of their venture. Although they returned with other foodstuffs as well, they were particularly dissatisfied with the amount of corn





Celestron® Multipurpose Telephotos

Let You Reach Out...

A long focal length telephoto lens is irreplaceable for many aspects of sports, nature and action photography—there are many times when only a "long" lens can achieve the right framing, isolate a subject against a complex background or provide the image scale you want for dramatic, artistic photographs.

Only Celestron offers a complete range of compact, mirror-lens telephoto lenses of 300 to 3910mm focal lengths that can also be used as visual spotting scopes and high quality, large aperture astronomical telescopes.

You are invited to see the multipurpose Celestrons at your local camera dealer and to learn about the full potential of a Celestron by sending for our beautiful, full-color, 52-page catalog describing our complete telephoto, astronomical telescope and binocular lines.

You'll be surprised at how little a Celestron costs—far, far below equivalent, bulky conventional telephoto lenses that have none of the versatility of a Celestron.



To capture the unusual
Celestron 750mm f/6 Photograph



Free 8-page brochure or send $3.00 for 52-page full-color catalog on how to select and use a Celestron telescope/telephoto lens.

Celestron® International
2835 Columbia St., (Box 3578-NH2)
Torrance, Calif. 90503, U.S.A.
Telephone: (213) 328-9560
Dealer inquiries invited.

American Museum of Natural History
Discovery Tours



GALAPAGOS ISLANDS CRUISE
June 5-17, 1982

Discover a naturalist's paradise: a volcanic archipelago straddling the equator and home to unique and tame animals. Share a relaxed holiday aboard the comfortable M.V. Buccaneer with three American Museum curators—all experts in their fields; ornithology/ecology, geology/volcanology, herpetology/evolution. Enjoy superb climate, sandy beaches, fantastic photographic opportunities, and good company. Limited to 65 passengers. For further information write to DISCOVERY TOURS, American Museum of Natural History, Central Park West at 79th Street, New York, NY 10024, or call (212) 873-1440.

Terry L. West



On the caravan accompanied by the author, above, there were fifty-five llamas, as well as three burros to carry utensils and provisions. Loads were rotated each day so that fatigued llamas could have a respite.

they had acquired: Sergio had fourteen cargoes of corn (700 pounds) and Gregorio only ten. Hilario declared his intention to work in Santa Cruz the next year and purchase maize in the valley with part of his earnings. None of them planned to travel with llamas any more.

Archeological evidence indicates that llama caravans existed in the Andes almost 4,000 years ago, but the system of interdependence that has for so long operated between highland drovers and their valley trade partners is breaking down under the impact of commercialism. Markets have eroded the barter system that prevailed for centuries, and middlemen, traveling in trucks and buying maize with cash, have forced down the exchange rates, which once were more favorable to drovers.

Traditionally, the primary goal of all drovers was the provisioning of their households, not monetary gain; they were concerned with the quantities of products traded, rather than their monetary values. This ideal is reflected in the traders' custom of not mentioning the cash value of exchange items during their transactions. Lately, however, migrant labor opportunities created by an

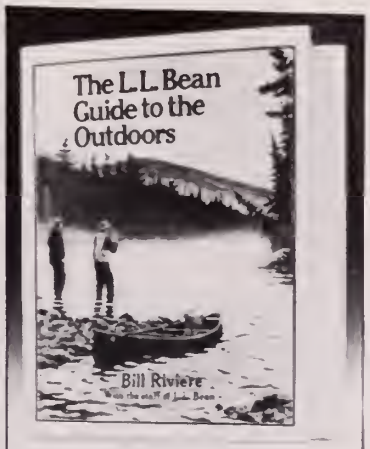


agricultural boom in the Department of Santa Cruz have induced the new generation to take a more calculating look at the economics of llama caravans. The young men of Pampa Aullagas do not consider the profits sufficient compensation for the effort that must be expended. They can earn enough as wage laborers in the same amount of time to buy the maize they need and still have money to spare.

While recent increases in the price of oil in some Andean regions appear to have given llama transport a new lease on life, there are other considerations that spell a permanent decline in the caravans of Pampa Aullagas. Following the introduction of tractors in 1972, agricultural production rose as lands formerly used for grazing were opened up to cultivation. This both reduced the need for llama ownership and constricted the amount of pastureland. About the same time, some local residents purchased large trucks, which are a more convenient form of transportation to the valleys, as well as to the nearby weekly market where maize and other valley products can be purchased. Finally, the construction of a secondary school has helped to deprive drovers of their apprentice helpers. Exposed to the opportunities and values of modern society, the youth of Pampa Aullagas have become both independent and disdainful of their parents' occupations. Many hope to be teachers or truck drivers or at least migrant workers, to earn money and emulate urban ways. To travel with or herd llamas is to them old-fashioned and even degrading. □

L.L.Bean

Outdoor Sporting Specialties



Handsomely illustrated.
336 pages, hard cover. Published by Random House, Fall 1981. **$14.95 ppd.**

The L. L. Bean Guide To The Outdoors

A complete guide to the clothing, footwear and equipment you need to make your time outdoors safe, comfortable and enjoyable. The L. L. Bean staff joins Bill Riviere, long time Maine Guide and outdoor writer, in providing accurate, well researched information on the materials, construction and designs of reliable outdoor products. Includes valuable tips on a wide range of topics such as outdoor cookery, back woods weather forecasting and finding your way in the wilderness. 150 drawings, handy reference charts and equipment lists.

CHAPTER TITLES

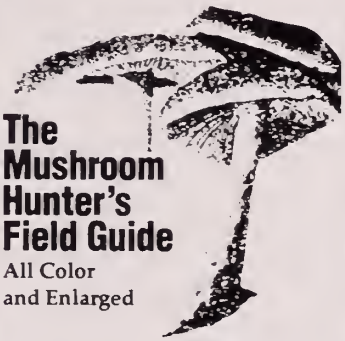
1. THE GREAT OUTDOORS
2. APPAREL
3. BOOTS AND SHOES
4. SLEEPING BAGS
5. SHELTER
6. PACKING GEAR
7. DINING UNDER THE SKY
8. WOOD TOOLS
9. WINTER TRAVEL
10. CANOES
11. NAVIGATION

Please Ship Postage Paid
____8414W Bean Guide To The Outdoors @ $14.95
☐ Check Enc. ☐ MC ☐ VISA ☐ AMEX
Card #_____
Exp Date _____

☐ **FREE FALL CATALOG**
Name_____
Address_____
City_____
State____ Zip_____

L. L. Bean, Inc., 781 Casco St., Freeport, ME 04033

Alexander H. Smith and
Nancy Smith Weber



The Mushroom Hunter's Field Guide
All Color
and Enlarged

"a forager's Bible,"
says Maxine Kumin.
"Alexander H. Smith is Moses. You'll want him on your side as you enter the Promised Land."
$14.95

The University of Michigan Press
Dept. A P.O. Box 1104 Ann Arbor MI 48106



Enter the world of Questers nature tours.

Stimulate your mind on a Questers tour.

We search out the plants and animals, birds and flowers... and explore the rain forests, mountains and tundra, seashores, lakes and swamps. Tours are under the leadership of a naturalist, and range from 9 to 35 days. There is ample time to photograph, absorb, reflect. Tour parties are small, accommodations are first class, and all meals are included.

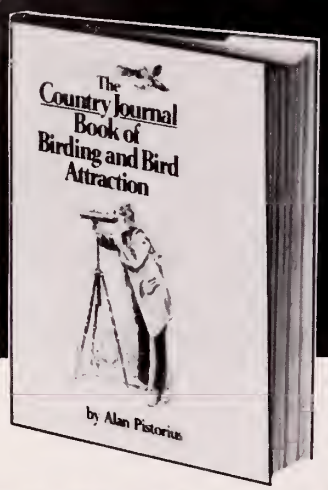
The current Directory of Worldwide Nature Tours describes tours to: *In Africa*—Zimbabwe, Botswana, Kenya. *In Asia*—India, Nepal, Bhutan, Sri Lanka. *In Australasia*—New Zealand, Australia. *In Europe*—Iceland, Greece, Spain, Switzerland, Scotland. *In the Americas*—Everglades, Alaska, Baja California, Hawaii, Pacific Northwest, Costa Rica, Panama, Amazon, Patagonia, Galapagos.

Write today for a free copy of the Directory of Worldwide Nature Tours.



QUESTERS
Questers Tours & Travel, Inc.
Dept. NH, 257 Park Avenue South
New York, NY 10010 • (212) 673-3120

A sensible, witty and richly informative guide to both "home" and "away" aspects of birding



With enthusiasm, humor, and accuracy, the noted *Country Journal* columnist takes the reader through the ins and outs of attracting and feeding birds at home—and through the major field birding events of the year. *Illustrated with drawings.*

$15.95 at all bookstores

Norton
W.W. NORTON & COMPANY, INC.
500 Fifth Avenue, New York 10110

Meshie Mungkut

In February of 1930, Harry Raven, a curator at the American Museum of Natural History, had just finished lunch in his camp in the great forest of the French Cameroons when two Africans emerged from the bush and approached him. One man carried a baby female chimpanzee in his arms. The African explained that he had shot the mother with a poisoned dart for food, and when he retrieved the body he had found the terrified infant chimp clinging to the dead mother's hair. The African had kept the animal as a pet for about a month and wanted to know if Raven was interested in buying it.

"I approached the man who held her," Raven wrote later, "and put out my arms. The little animal looked at me a moment, then stretched her arms toward me and I took her. She grasped me tightly as if she might fall." Raven bargained with the man through an interpreter and after much haggling acquired the chimpanzee. This purchase marked the beginning of one of the first attempts to raise a chimpanzee as a child in a human family.

Raven kept the chimp with him while the Museum expedition he was on traveled for more than 2,000 miles in Africa. When Raven returned to his temporary house in the Cameroons, he let the chimp have free run of the town. She played with the local children, who began calling her Meshie Mungkut, which loosely translates as "little chimpanzee that fluffs her hair up to look big."

In a year Raven's work in Africa was finished, and he took Meshie across the Atlantic in a steamship. One cold February day in 1931 they arrived in Boston. According to Raven, "Meshie was very much excited and interested in the things she saw and heard. I think the outstanding incident of Meshie's arrival in the United States was her alarm on seeing a team of horses while she was being driven across Boston in a taxicab. . . . Upon seeing a team of great dappled gray draft horses blowing clouds of steam through their nostrils, she uttered a little scream and grabbed me around the neck. . . . Meshie actually got down on the floor once in an effort to get as far away as possible, but a moment later she was back looking out the window."

Anthropologist Harry Shapiro, a colleague of Raven's in the Museum, who is now curator emeritus, recalls Meshie's life with the Ravens.

"Harry [Raven] arrived at his house one winter's evening. After the first greetings with his wife and children, he reached into a large pouch and pulled out the baby chimp. Harry treated Meshie just like another child in his family and raised her accordingly. The Raven kids, well, they treated her as a sibling.

"It wasn't a scientific experiment, mind you, but as far as I know this was the first time a chimpanzee was raised as a human. Of course, there have been



Meshie's mounted body on display in the Hall of Primates

AMNH

Ownership Statement

Statement of ownership, management, and circulation (required by 39 U.S.C. 3685) of *Natural History*, published twelve times a year at the American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024, for October 1, 1981. General business offices of the publisher are located at Central Park West at 79th Street, New York, N.Y. 10024. Publisher, David D. Ryus; editor, Alan P. Ternes, Central Park West at 79th Street, New York, N.Y. 10024. Owner is the American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024. Known bondholders, mortgagees, and other security holders owning or holding one percent or more of total amount of bonds, mortgages, or other securities: None. The purpose, function, and non-profit status of this organization and the exempt status for federal income tax purposes have not changed during preceding 12 months (Section 132.122, Postal Service Manual).. The average number of copies of each issue during the preceding 12 months are: A. Total number of copies printed: 500,048; B. Paid circulation: 1. Sales through dealers and carriers, street vendors, and counter sales: 11,699; 2. Mail subscriptions: 453,813; C. Total paid circulation: 465,512. D. Free distribution by mail, carrier, or other means: 6,708. E. Total distribution: 472,220. F. Copies not distributed: 1. Office use, leftover, unaccounted, spoiled after printing: 9,529. 2. Returns from news agents: 18,299. G. Total: 500,048. The actual number of copies of single issue published nearest to filing date are: A. Total number of copies printed: 503,642. B. Paid circulation: 1. Sales through dealers and carriers, street vendors, and counter sales: 13,135. 2. Mail subscriptions: 455,382. C. Total paid circulation: 468,517. D. Free distribution by mail, carrier, or other means: 6,971. E. Total distribution: 475,488. F. Copies not distributed: 1. Office use, leftover, unaccounted, spoiled after printing: 7,609. 2. Returns from news agents: 20,545. G. Total: 503,642. I certify that the statements made by me above are correct and complete.

David D. Ryus, Publisher

many such experiments since. We were all just fascinated with how 'human' this chimp was. She did all the little things that human children do—she was socialized as a human child."

In his backyard, Raven built Meshie a house that consisted of a box attached to the top crossbar of a swing set. The box had a sliding door and stood eight feet off the ground, as chimpanzees, being arboreal, are nervous about sleeping near or on the ground. Every evening Raven stood under the house holding a pile of blankets, and Meshie leaned out the door and caught them one by one as he tossed them up. Inside the house the chimp twisted the blankets into a nest, and in the morning, upon rising, she carefully dropped the blankets one by one to the ground.

Meshie was a habitué of the Museum, where she was a model visitor. "She would ride around," Shapiro recalls, "on a tricycle through the long fifth-floor halls. At lunchtime she would go down the elevators and eat with us in the old staff dining room. She had perfect manners and always ate with a knife and fork, although she sometimes was a little impatient with the waitress. I remember one extraordinary incident in particular. I was having lunch with Harry and Meshie, and after eating Harry got out a cigarette and put it in his mouth. He turned to Meshie and tossed a book of matches in front of her, saying, 'Meshie, light my cigarette.' Meshie sat there and looked at the matchbook. Harry repeated his order in a very strict, firm voice. This time Meshie picked up the matches, then dropped them in fright. Harry again repeated the order, and this time Meshie picked up the matches and took out a match before dropping them in fear. She obviously knew what the matches were and was afraid of fire. Finally, after Harry insisted several more times, Meshie lit his cigarette."

Raven made a silent film of Meshie that shows the chimp's daily activities at the Raven household. Meshie is seen pulling a sled, bouncing on a bed with the Raven children, eating with a spoon and drinking with a straw, riding a tricy-

Bagpipes Call Our Men
To Battle. We Also have Something
To Call Them home.



The first bagpipes were intended to strike fear into the hearts of our enemies.

Our own brave men, however, found the sound a source of pride and inspiration. Let the piper skirl and we feel moved to march off to just about anyplace.

But then we have powerful calls to return home, too. One of which is a scotch that whispers. J&B Rare Scotch is specially and selectively blended to have a most agreeable and pleasant taste.

It's carefully chosen from the finest whisky in the land.

Why did we create a scotch that whispers? Well because, you can't spend a quiet evening with a bagpipe.

To send a gift of J&B (bottle or case) anywhere in the continental U.S.* call: 1-800-528-6148.



J&B. It whispers.

86 Proof Blended Scotch Whisky. © 1981 The Paddington Corp. NY

*Except where prohibited

Better Than Jogging



NordicTrack

Jarless Total Body Cardiovascular Exerciser

Duplicates X-C Skiing for the Best Motion in Fitness

Highly Effective and Pleasant To Use
The enjoyable sport of cross-country skiing is often cited as the most perfect form of cardiovascular exercise for both men and women. Its smooth, fluid, total body motion uniformly exercises more muscles and higher heart rates seem easier to attain than when jogging or cycling. NordicTrack closely simulates the same pleasant motion and provides the same cardiovascular endurance-building benefits — right in the convenience of your home. Makes a year round, consistent exercise program easily attainable. Eliminates the usual barriers of time, weather, chance of injury, etc. Also highly effective for weight control.

Better Than Running
NordicTrack gives you a more complete work out — conditions both upper body and lower body muscles at the same time. Fluid, jarless motion will not cause joint or back pains as jogging or running often does.

Better Than Exercise Bikes
NordicTracks stand-up skiing motion more uniformly exercises large leg muscles and also adds important upper body exercise. Higher pulse rates, necessary for building fitness, seem easier to attain because the work is shared by more muscle mass. The NordicTrack also keeps more muscles in tone.

Even Better Than Swimming
NordicTrack more effectively exercises the largest muscles in the body, those located in the legs and buttocks. These muscles main function is to lift and propel the body in the standing position. When swimming, the water supports the body thus preventing these muscles from being exercised as effectively as when they support the body in a standing position as when using the NordicTrack.

A Proven, high Quality Durable Product
Ruggedly constructed, NordicTrack is quiet, motorless and folds compactly for storage. Separate arm and leg resistances. NordicTrack is in its 5th year of production and is used in thousands of homes and many companies. We manufacture and sell direct. Our No-Risk 15 day trial guarantee shows our confidence in your being pleased with the performance and quality of the NordicTrack.

For more information, call or write
PSI 124 L Columbia ct. Chaska, MN 55318
toll free 1-800-328-5888 8 - 5 Mon - Fri
Minnesota 612-448-6987

cle around the neighborhood, taking a bubble bath, playing tug of war, and squirting water from a hose into the upper-story windows of the Raven house. In one sequence, Meshie picks up a baby in the family, carefully carries her to a high chair, brings over her food in a bowl, and feeds her with a spoon. After the baby is finished eating, Meshie fetches a damp cloth and neatly wipes clean the baby's tray. Meshie was adept at escaping from any kind of cage or leash, and one sequence in the film shows her untying herself from a tree by loosening the knot with her teeth, pulling open the knot's loop, climbing through the loop, and scurrying away. If the rope were double- or triple-knotted, she would simply climb through the knot's loops several times, a rather sophisticated piece of topological reasoning. Meshie also learned how to open a padlock by packing it with sand, how to break an iron chain by knotting it and then pulling, and how to remove leather collars by wetting them over and over again with her tongue until they became brittle. If put in a cage, she would endeavor, sometimes with success, to pry or bash her way out. In many ways Meshie was curiously "human." In the movie, for example, she walks upright most of the time instead of walking with her knuckles on the ground. And Raven reported that, like many New Yorkers, the chimp had a pasty white complexion in winter but tanned a rich brown in the summer.

Exactly how much coaching Meshie got in performing many of her tricks is unclear, but it was considerable. If primatologists were to study the movie today (none have, surprisingly enough), they probably would disagree about how much Meshie was being "cued" and to what extent her actions were simply imitative. But no one would disagree that Meshie led an extraordinary life for a chimpanzee—or even for a human. Meshie lunched with many prominent citizens, including Museum president Henry Fairfield Osborn, Mr. and Mrs. Ralph Pulitzer, and the novelist Edna Ferber. The high point of the chimp's social career in New York was described by Raven in 1933:

> Not long ago Meshie had the honor of being the guest of President F. Trubee Davidson of the American Museum of Natural History at a formal banquet at the Waldorf-Astoria. What could be stranger, more unlike her former home in the African forest, than the ride across Manhattan in a taxicab, the brightly lighted hotel with the gaily-dressed people everywhere, the brass band and Negro minstrels! But she rode her kiddie car through the foyer, into the banquet hall crowded with strangers, and took her place at the table with the rest of the guests. She politely ate some of each course as the dinner was served, sat quietly while the speeches were made, blinked while the press photographers took more than a dozen flash-light photographs of her, and did not get home until long after midnight.

Meshie spent about five years with the Ravens in their Long Island home. Her final year with them was one of increasing difficulty, according to Shapiro:

"When Meshie became sexually mature at about six years old she became a real problem. Meshie thought of Harry as her father, and he was really the only one who could control her. Mrs. Raven often had to call Harry at the Museum because of Meshie, and he would have to rush home. They didn't know what to do. Finally Mrs. Raven insisted that Meshie go, and so they sold her to a zoo in Chicago.

"About a year or so later I ran into Harry in the hall at the Museum. He was very upset. He told me he had been passing through Chicago and decided to see Meshie at the zoo. The zookeeper warned him that Meshie had become absolutely wild and dangerous. Sure enough, as Harry approached her cage he could hear her screaming and banging on the bars and carrying on. The zookeeper didn't want to let Harry go into the cage, but he insisted. When he went in, Meshie rushed into his arms and clung to him tightly. Tears were streaming down her face."

Meshie died in childbirth a year later, and the zoo shipped her body back to the Museum, where it was mounted and put on display in the Hall of Primates. No label indicates the animal's identity, but it is said that Raven stopped by the hall once in a while and gazed thoughtfully at the stuffed chimp with the glass eyes. "I suppose," said Shapiro, "it was kind of a memorial for him."

Douglas J. Preston

Harry Shapiro will introduce and show the film about Meshie made by Harry Raven in the 1930s in a special program open only to Museum members. *Bringing up Meshie* will take place on Wednesday, December 16, at 7:30 P.M. in the Museum's Auditorium. The program is free, but advance tickets are required. Call the Membership Office at (212) 873-1327 for ticket availability.

Reality behind Myth

Claireve Grandjouan, professor of classics and a popular Museum lecturer, will give an illustrated talk, *Land and Gods*, on Wednesday, December 2, at 7:00 P.M. in the Auditorium. The lecture will explore the relationship between nature and the personalities of many ancient Greek and other Mediterranean gods, including Baal, Zeus, Vulcan, and Bacchus. Tickets for the evening are $5 for members and $6 for nonmembers and may be purchased in advance from the Museum's Education Department.

Vanishing Jungle

The tropical rain forest, popularly known as the jungle, is the focus of a symposium at the Museum on Wednesday, December 9, from 6:00 to 8:00 P.M. in the Auditorium. Three speakers will discuss the future of the earth's great rain forests, where about half of all animal and plant species live. Moderator Russell E. Train, president of the World Wildlife Fund-U.S., will be joined by Thomas Lovejoy, Ghillean Prance, and George Woodwell in a program of slides and discussions about the threatened ecologies of the rain forest. Tickets are $6 for members and students and $8 for nonmembers.

Swamp, Ocean, and Fig

New Natural History Films is the title of a free weekend program on December 5 and 6. Three new films will be shown in the Auditorium on both Saturday and Sunday at 1:00, 2:00, and 3:00 P.M. At 1:00 P.M., *Pantanal*, a film about the 100,000-square-kilometer marsh south of Brazil's Matto Grosso, will be shown. At 2:00 P.M., *Dive to the Edge of Creation* takes the viewer down to the mid-oceanic ridges where hot water vents and a sulphur-rich solution support a variety of unusal, nonphotosynthetic life forms. *Amate*, a film about an ancient fig tree, its life cycle and microhabitat, will be shown at 3:00 P.M.

Carved Birds

An exhibition of exquisitely carved birds is currently on display in the Roosevelt Rotunda. Created by Mary and Porter Brown, the life-sized birds are hand-carved of basswood and are accurate down to the fine details of individual feathers. The exhibition also includes carving tools and information on how the birds were carved. The Browns' work was recently featured in an article in *Sports Illustrated*.

Haitian Highlights

On the weekend of December 5 and 6, a program of Haitian arts, crafts, folk dances, and music, including a lecture by Henry Frank on voodoo, will be presented in the People Center. Entitled *Panorama of Haiti*, the free program, presented by the Education Department, runs from 1:30 to 4:00 P.M. on both days.

Caribbean Christmas

The celebration of Christmas in the Caribbean is the focus of a free program in the People Center on December 12 and 13. This Education Department program, which includes folk music and dance, and arts and crafts in different areas of the Caribbean, runs continuously from 1:30 to 4:00 P.M. on both days.

Dance Potpourri

The Allnations Dance Company, a multiethnic troupe, will give a free performance on Sunday, December 13, at 2:00 P.M. in the Auditorium. In a program entitled *Joy in Every Land*, the troupe will perform dances from Appalachia, Mexico, China, Tahiti, Barbados, the Philippines, and Kenya, among other places.

For more information about programs or events, contact the appropriate Museum department: Education Department (212) 873-7507; Membership Department (212) 873-1327; Hayden Planetarium (212) 873-1300, ext. 389; or write to the department at the American Museum of Natural History, Central Park West at 79th Street, New York, N.Y. 10024

Any project worth starting is worth finishing with Behlen.



Quality woodwork deserves a quality finish. That's why, since 1888, the world's foremost professional finishers and cabinetmakers have insisted on H. Behlen & Bros. Finishing Products.

Now you can do the same. Because, although normally available only in industrial quantities, Behlen finishing supplies can now be ordered from Garrett Wade in quantities packaged for the amateur or small professional shop.

Our extensive selection of Behlen products includes:

- Removers
- Burn-in Sticks
- Aniline Dyes
- Pigment Stains
- Coloring Agents
- Varnishes
- Lacquers
- Shellac Flakes
- Rubbing Materials
- Oil Finishes
- Waxes
- Brushes & Cleaners
- Bleaches
- Padding Lacquers

By using only the purest, most carefully selected ingredients, Behlen products take the mystery out of obtaining professional finishing results—and add the perfect "finishing touch" to all your wood-working projects.

GARRETT WADE COMPANY
The Yankee Wood Craftsman

Garrett Wade Co. *161 Ave. of the Americas N.Y., N.Y. 10013, Dept. 34*

Send me the following Behlen products (a free Garrett Wade finishing supplies catalog will be included with each order). ☐ Send me the finishing supplies catalog for 25¢.

Qty			
_____	99P02.01	1 lb Special Powdered Paint Remover	$ 4.75 ppd
_____	99P03.01	1 Qt Silex Based Natural Filler	$ 7.90 ppd
_____	99P28.01	1 Qt Pure Tung Oil	$13.15 ppd
_____	99P27.01	1 Pt (FDA Appr.) Salad Bowl Finish	$ 4.85 ppd
_____	99P23.01	1 lb Button Lac Shellac Flakes	$ 8.00 ppd
_____	99P24.01	1 lb Super Blond Shellac Flakes	$13.15 ppd
_____	99P25.01	1 Qt Behkol Pure Anhydrous Alcohol	$ 3.30 ppd

Amount Enclosed (Add Sales Tax for N.Y. State Residents) _____

Name_____

Street Address_____

City_____ State_____ Zip_____

☐Check/Money Order ☐Visa/Master Card/American Express

Card No._____ Expires_____

THE MARKET

Art

AFRICAN ELEPHANT IN STAINED GLASS. Limited edition of 175 hand crafted panels. For window or wall. 12½" by 17". Framed in oak. $160. Brochure 50¢. The Glass Reunion, 7145 Joan St., Denver, CO 80221

AUDUBON PRINTS, original handcolored birds and animals. Write Audubon, 9720 Spring Ridge Lane, Vienna, VA 22180

BEAUTIFUL CIBACHROME PRINTS: numbered and signed by the artist, illustrated literature. G. Anthony, 2030 Duck Lake Rd., Whitehall, MI 49461

PRE-COLUMBIAN COLLECTIBLES



GODDESS OF THE NEW MOON. AT'ACTANI —one of many splendid Mayan rubbings/serigraphs! Full-color catalog $2.00 (refundable first purchase).

BERNARDO
2400 Westheimer Road
Suite 108 West (NH12)
Houston, Texas 77098

BUDDHA MASK, Taiwan, 10", wood, $29, request photo, other masks available, McCoy Imports, Liberty, NY 12754

FOR THE WILDLIFE ENTHUSIAST. A new high quality color lithograph 13½ × 19 of nesting Wood Ducks. Limited edition, signed and numbered. Free brochure. Albert Joransen, 4209 78th Avenue N., Brooklyn Park, MN 55443

FREE! COLOR BROCHURE, Large National Park Prints by M. Woodbridge Williams, Photo Classics, Dickerson, Maryland 20753

NOTECARDS/NOTEPAPER. Rocky Mountain sketches for Holiday greetings or gifts. Send $5.00 for samples, redeemable with order. Lion's Eye Graphics, P.O. Box 562, Grand Lake, Colorado 80447

Astronomy

ASTRONOMY TO ENJOY: Beginners and kids love this telescope—great views, ultra-simple: Astrocan, $209. The clearest star-finder, easy and elegant: The Bowl of Night, $62.95. Colorful cardboard kits: Sundial $3.95, Armillary $4.95, Sextant $8.95, Astrolabe $11.95. Our own popular astro talks, formal or hung loose, $150 + expenses. Everything in the Universe, 17-N Thorpe St., Somerville, MA 02143. After Solstice: 89-N Dominican Dr., San Rafael, CA 94901

Book Publishers

PUBLISH YOUR BOOK! Join our successful authors. Publicity, advertising, beautiful books. All subjects invited. Send for fact-filled booklet and free manuscript report. Carlton Press, Dept. NHL, 84 Fifth Avenue, New York 10011

Books

BOOKFINDING. Librarians search worldwide titles or subjects plus 150,000 indexed stock. PAB, 2918 Atlantic, Atlantic City, NJ 08401 (609) 344-1943

PUBLISHERS' OVERSTOCKS, BARGAIN BOOKS. 2,000 titles, all subjects! Free catalogue. Hamilton's, 98-55 Clapboard, Danbury, CT 06810

"THE CHINA ALBUM"—Over 450 mostly color photos and graphic descriptions of a 1980 tour across China covering schools, factories, hospitals, tourist sites, communes, Canton trade fair, by plane, train, bus. Gives a feel of China emerging as major economic power. L.A. Times 'Notable' Review. 8½ × 11, 130 pages $15.00. Send cash, check or money order to Howard Nielsen, 2540 Page Drive, Altadena, CA 91001

YESTERDAY'S BOOKS LOCATED, no obligation. Out-of-State Book Service. Box 3253J, San Clemente, CA 92672-1053 (714) 492-2976

Collectors' Items

500,000 + BEAUTIFUL FILMUSIC Soundtrack Recordings! Catalogue—$1.00. Soundtrack Valueguide—$5.50. RTSN, Box 687, Costamesa, California 92627

Correspondence

MAKE FRIENDS WORLDWIDE through international correspondence. Illustrated brochure free! Hermes-Verlag, Box 110660/NH, D-1000 Berlin 11, West Germany

ORIENTAL WOMEN SEEK CORRESPONDENCE for cultural exchange, language practice, friendship. Asian Exchange, Honokaa, Hawaii 96727

PENFRIENDS-ENGLAND-USA. Make lasting friendships through correspondence. Send age, interests. Free reply. Harmony, Box 89NH, Brooklyn, NY 11235

Education

COLLEGE BOUND? Research develops amazing new process revealing college best for you. $5, Box 6034, Winston-Salem, NC 27109

"DIG ROCK" Geology Game—Learn While Playing. Have Adventures—Collect Minerals, Gems. Informative Booklet, Board, More—All Ages—$19.95. Kingworthy Educational Games, 115 Emerson Drive, Great Neck, NY 11023

EROS-LANDSAT IMAGERY—2 x 2 slides with explanation—Topics include five sets—Crustal Dynamics $40, Rivers $40, Coastlines $36, Environment & Conservation $36, and Glaciers $24. See how the earth looks from a satellite 570 miles up. Science by Saia, P.O. Box 346N, Deer Park, NY 11729

Employment Opportunities

AUSTRALIA NEEDS YOU! Jobs! Paid Transportation! Newest handbook, $2.00 (guaranteed). Australian International Services, Box 19107-RZ, Washington, DC 20036

AUSTRALIA—NEW ZEALAND NEED YOU! Big pay! 50,000 Jobs! Free transportation. Latest listings $2.00. Austco, Box 772, Cypress, CA 90630

FREE DETAILS—OVERSEAS JOBS! All occupations! 68 countries. Paid fare. Computerized reports. Jobworld, Box 681, Cypress, CA 90630

OVERSEAS—ALL OCCUPATIONS! Worldwide Directory and complete information—$3.00. International Opportunities, Box 19107-RZ, Washington, DC 20036

ROCKY MOUNTAIN EMPLOYMENT NEWSLETTER! Colorado, Idaho, Montana, Wyoming! Current openings—all occupations! Free details . . . Intermountain 4Y, 3506 Birch, Cheyenne, WY 82001

Foreign Newspapers

WORLDWIDE ENGLISH NEWSPAPERS. 65 countries including Australia. Sampler: 5/$2.98. Free Brochure. Multinewspapers, Box DE-212, Dana Point, CA 92629

Gourmet Interests

BEER BREAD: Great for snacking and easy to make. Send $1.00 to: Beer Bread, P.O. Box 0186, College Grove Station, San Diego, CA 92115

EASY NUTRITIOUS SEAFOOD. Recipes from an old fisherman. Send $2.00. P.O. Box 971233, Miami, Florida 33197

FLAVOR WINTER SOUPS, stews, chowders with native Carolina Bay leaves. Ten gram packet $2.00 with SASE. Herbs, Box 685, Carrboro, NC 27510

MINNESOTA WILD RICE. $7.00 pound, five pound minimum. Floura Bros., Box 44C, Blackduck, MN 56630

"MOUTH WATERING DESSERTS" Gourmet Chef will share recipes. $2.00. "Recipes," P.O. Box 3, Oceanside, NY 11572

TEXAS ORIGINAL JALAPENO PEPPER JELLY Recipe—Authentic Spicy—Delicious—$2.50. 121 W. Pipeline, Hurst, Texas 76053

VERMONT MAPLE SYRUP. Gift Boxed, two pints grade A, from our Farm. Packed in attractive, fingerjointed, reusable, wooden box. $12.50, shipping $3.00, W. of Miss. $4.75. New Morning Farm, Bethel, Vermont 05032

Government Surplus

"GOVERNMENT SURPLUS DIRECTORY." Buy 500,000 items (including Jeeps) . . . low as 2¢ on dollar! Most complete information available—$2.00. Disposal, Box 19107-RZ, Washington, DC 20036

JEEPS, CARS FROM $35.00! 700,000 Items! Government Surplus—Most Comprehensive Directory Available Tells How, Where To Buy—Your Area—$2—Moneyback Guarantee—"Surplus Information Services," Box 3070-DC11, Santa Barbara, California 93105

Merchandise/Gifts

EDELWEISS PLANT of nostalgia and romance, perennial for garden or pot $15, seeds $10, flower $5, dry arrangement $25 ppd. Szarotka, P.O. Box 366, Portland, OR 97207

"I LIKE IT WILD®. . ." Wilderness/wildlife posters, T-shirts, note cards. Send stamped envelope: Wilderness Dreams®, Box 4455-N, Shawnee Mission, KS 66204

LIFE-SIZED STUFFED STEIFF lion, giraffe, panther. Call after 9:00 P.M. (201) 256-0328

LION, EAGLE, BEAR TOTES: $4.50, Tee Shirts: $5.50. 25¢ Brochure. Joan's Art, Rt. 100, Box 316, Spring City, PA 19475

NATURAL BALSAM WREATH. Beautiful 20" Christmas Wreath hand crafted from fresh cut Northern Michigan Balsam, with decorative bow, holiday berries, and pine cones. $8.95 each post paid or two to the same address $15.95. Satisfaction guaranteed or 100% refund. Order now for shipment before Dec. 10th. We can enclose gift card for shipment to others. W. W. Carmody Co., Inc., 9998 Lindeman Rd., Bear Lake, MI 49614

PURCHASE Bowie, Civil War knives, Indian tomahawks. Robert Abels, 2881 N.E. 33 Court, Fort Lauderdale, FL 33306

TRAVELING NOSTALGIA—Famous 1940's Southern Pacific "Daylight" train luggage label reproduction. 2/$2. F. Kaiser, Box 864, Danville, CA 94526-0864

Music

RECORDS-TAPES! Discounts to 73%. All labels; no purchase obligations; newsletter; discount dividend certificates. 100% guarantees. Free details. Discount Music Club, 650 Main Street, P.O. Box 2000, Dept. 25-1281, New Rochelle, NY 10801

Optical

BINOCULAR SALES AND SERVICE. Repairing binoculars since 1923. Alignment performed on our U.S. Navy collimator. Free catalogue and our article "Know Your Binoculars," published in Audubon Magazine. Mirakel Optical Co., Inc., 331 Mansion St., West Coxsackie, NY 12192 (518) 731-2610

LEITZ, ZEISS, B&L, SWIFT, BUSHNELL, NIKON Optolyth binoculars, telescopes and accessories. Send stamp for discount list. Specify literature desired. Large stock. Orders filled postpaid day received. Birding, Box 5N, Amsterdam, NY 12010

OPTIC DISCOUNTS: Binoculars—Telescopes—Brand Names—Free List. Thos. Manetta, Box 12—61 Hoffman Avenue, Elmont, NY 11003

Personals

MEET SINGLES Mexico, Orient, Europe, Australia. Free information. Write: International, Box 1716-NH, Chula Vista, CA 92012

Photography

CASH WITH YOUR CAMERA! Earn $5,000-$15,000 yearly selling to 4,000 clients. Sell photos 15 or more times. Guaranteed details—25¢. Pictureprofits, Box 479-NH-1, Port Jefferson Station, NY 11776

THE FLYING EAGLE®: Finest laser color reproductions of the ultimate Bald Eagle photograph. 16 x 20 Fine Art Print, $20. Kenneth R. Hunter, Ph.D., Egegik, Alaska 99579

Real Estate

FREE! Big Fall-Holiday Catalogue! Over 5,400 country properties described, pictured! Land, Farms, Homes, Businesses, Waterfront, Recreation, Retirement buys! Selected best thruout the U.S. Over 700 offices, 43 states All Across America! Yours Free from the World's Largest! Strout Realty, Inc., 60 E. 42nd Street, Dept. 5390, New York, NY 10017

FREE . . . 296-PAGE CATALOGUE. Describes and pictures over 2,800 farms, ranches, acreages, businesses and town and country homes from coast to coast. United Farm Agency, Inc., 612-V W. 47th St., Kansas City, MO 64112. Ph. Toll-Free: 1-800-821-2599; MO. Res. Ph. Toll-Free: 1-800-892-5785

GOVERNMENT LANDS . . . FROM $7.50/ACRE! Homesites, farming, vacationing, investment! "Land Buyer's Guide" plus nationwide listings—$2.00. Lands, Box 19107-RZ, Washington, DC 20036

Resorts

BRITISH VIRGIN ISLANDS. Virgin Gorda. Deluxe seaside villa rental. Fully equipped 3 BR, 3 BTH. Spectacular view. Private beaches. Write Hartley, 125 Barn Run Ct., Huntington Station, NY 11746

CROSS-COUNTRY SKI LODGE. Remote, quiet, 10 guest maximum. Suana, unusually good food. Gulf Hagas Gorge. Little Lyford, Brownville, ME 04414 (207) 695-2821

FAR OFF THE BEATEN TRACK. . . . Very small, very special hotel tucked into a 30 acre plantation on the island of Bequia, St. Vincent Grenadines, W.I. 10 rooms, fresh water pool, beautiful beach, snorkeling, hiking, photography, birding, tennis. Write or call: Spring on Bequia, Box 19251, Minneapolis, MN 55419, (612) 823-1202, or your travel agent. Member of Distinguished Inns and Historic Hotels.

ST. JOHN, VIRGIN ISLANDS apartment for two. Vacation: swimming, snorkeling, exploring National Park. $325 weekly. Barsel, Box 114, St. John, U.S.V.I. 00830

TOBAGO, PRIVATE BEACH COTTAGES on working cocoa plantation. Swimming, snorkeling, fishing from your front door. Bird watcher's paradise. Brochure. Charles A. Turpin, Charlotteville, Tobago, West Indies

VACATION/RELAXATION—Birdwatcher's delight—Peaceful, secluded nature lover's mountain retreat. Cave Creek Ranch, Portal, Arizona 85632

Tours/Trips

ADIRONDACK WILDERNESS SKI TOURS. Enjoy the exhilaration and beauty of a northern winter in the company of expert naturalist guides. Cross-country trips into "forever wild" Adirondack Forest Preserve. Explore habitats of deer, beaver, bobcat, coyote, bear, fox, otter, pine marten, fisher, mink. Evenings spent in cozy backcountry lodge enjoying hearty homecooked meals, good company, and fireside programs with noted ecologists, historians, photographers, and conservationists. Write: Adirondack Ski Tours, McMaster Rd., Saranac Lake, NY 12983. Or call: (212) 546-9202

ADVENTURE TRAVEL: Tanzania, Camping Safaris, Peru natural history, Himalayan Treks, Australian Adventures. Special birdwatching and natural history departures. Overseas Adventure Travel, 1430 Mass. Ave. #303N, Cambridge, MA 02138 (617) 876-0533

AFRICA, NEPAL, SOUTH AMERICA—Top Quality wildlife safaris. Very small groups, expert naturalist leaders. Winter and summer departures. For our free catalogue write: Wilderness Travel, 1706-NG Solano Ave., Berkeley, CA 94707. (415) 524-5111

BIRDING CALIFORNIA, Baja and west coast Mexico with Dr. Dennis Paulson. Washington wildflowers. X-C British Columbia. Alaska and Hawaii. Brad's Tours, 401 E. Mercer 31D, Seattle, WA 98102

BIRDS AND MAYA RUINS: 2-week special trip with Princeton's Stony Brook-Millstone Watersheds Assn., March 14-28, 1982 to Mexico's Yucatan and Palenque. Four guides, deluxe accommodations, relaxed pace. Tropical birding at its best. Call or write: Princeton Nature Tours, 282 Western Way, Princeton, NJ 08540 (609) 924-5258

CROSS-COUNTRY SKI from hut to hut in the high Wallowa Mountains of northeastern Oregon. Or hike and learn in the River of No Return Wilderness of Idaho. Trips for all abilities, everything provided and small groups. Write: Wilderness Trails, P.O. Box 9252N, Moscow, Idaho 83843 (208) 882-1955

DISCOVER BAJA! Join professional naturalists & crew for ocean going exploration of Baja's wilderness islands and lagoons. Gray whales up close, elephant seals, superb birding & lots more! Excellent photo opportunities, small groups. Color brochure. Pacific Adventures Charter Service, 2445 Morena Blvd., Suite 200H, San Diego, CA 92110

ECONOMIC GALAPAGOS. Weekly departures. Seven or fourteen nights in Galapagos with optional Ecuador, Amazon, Peru. University credit available; non-students welcome. Dr. R. Lainhart, Biology Dept., Towson State University, Towson, MD 21204 (301) 321-2443 or 922-3116

FASCINATING NATURE, LEGENDARY CULTURES: Uncommon Travel programs to Latin America (featuring Peru, Galapagos, Amazon), Africa (even Rwanda, Madagascar!), Europe. Groups/Freelance. Forum Travel, 2437 Durant, Berkeley, CA 94704 (415) 843-8294

FREIGHTER CRUISES—First Class—Exotic—$50 daily and less. TravLtips Freighter Association, 16309-B5 Depot Road, Flushing, NY 11358

GALAPAGOS HIKING AND SAILING EXPEDITIONS. Small groups. 1982 dates: February 4, April 22, July 7, August 4. Charters. Machu Picchu options and Chili ski options. Inca Floats, 5982N Balboa, Oakland, CA 94611 (415) 339-9095

HORSE-DRAWN ODYSSEY—Greece. Rural, Ancient, Modern. Two weeks, April. All ages. Grassroots Expeditions, Freedom, Maine 04941 (207) 342-5422

INDIA/NEPAL WILDLIFE SAFARI: Outstanding game observation in three major reserves + Delhi, Taj, Kathmandu, Himalayas. $1375.00. Also, comprehensive program of trekking expeditions in Nepal's Everest & Annapurna regions from $895.00. Airfares additional. Free brochure. Himalayan Travel, Inc., Box 481-NH, Greenwich, CT 06830. Toll Free (800) 243-5330

LEARNING ADVENTURES. Van safaris of the Southwest, Box 214, Boulder City, NV 89005 (702) 293-5758

MAYA & INCA: "1982 Art, Architecture and Archeology" Field Trips, with Nicholas Hellmuth. Seldom visited Yucatecan/Peruvian sites. Other unusual programs. Forum Travel, 2437 Durant, Berkeley, CA 94704 (415) 843-8294

NATURE TOURS to all parts of the world. Free brochure listing 1982 tours to Texas, Arizona, Oregon, Washington, Costa Rica, Panama, Peru, Greece, Spain, Morocco, Iceland, Malaysia, China, India/Nepal. World Nature Tours, Box 693a, Silver Spring, MD 20901

NEW ZEALAND WALKABOUT: A selection of escorted nature and hiking tours, featuring New Zealand's scenic National Parks, the Milford Track, Farm Holiday Stay. Pacific Exploration Company, Box 3042-N, Santa Barbara, California 93105

SCOTTISH HIGHLANDS, Wildlife trips weekly April-October. Other wildlife destinations include Shetland, Orkney, Iceland, Tanzania, Canary Islands, Nepal, Texas, Arizona & California and Alaska. Also backpacking and trekking in Nepal, Peru, Bhutan and Scottish Highlands. Expert leadership. Write: McGregor Travel, 33 Lewis Street, Greenwich, Connecticut 06830, or call: (800) 243-5330

SERENGETI: MIGRATION OF WILDEBEEST. 1982 departures. Send for details. Overseas Adventure Travel, 1430 Mass. Ave. #303N, Cambridge, MA 02138 (617) 876-0533

WILDLIFE ADVENTURES—Whale watch cruises with gray whales, humpback whales and even blue whales. African photo safaris view gorillas in Rwanda, wildlife and birds in Kenya, Tanzania, Zambia, Botswana and Madagascar. New brochure 24 trips is available. Adventures International, Dept. NC, 4421 Albert, Oakland, CA 94619

RATES AND STYLE INFORMATION

$1.75 per word, 16 word ($28) minimum. *Display classified* is $150 per inch. All advertisements must be prepaid. Rates are not structured for agency or frequency discounts. All advertisements are accepted at NATURAL HISTORY's discretion. Send check/money order payable to NATURAL HISTORY to: The Market, NATURAL HISTORY Magazine, Central Park West at 79th St., New York, NY 10024. Please include your personal address and telephone number, issue preferred, and suggested heading. Deadline—1st of the month, two months prior to cover date (the January issue closes Nov. 1). Camera-ready art is required for display ads. A tearsheet or copy of the page with your ad will be sent upon publication.

Celestial Events

by Thomas D. Nicholson

The Moon The four-day-old crescent moon of December 1 is in Capricornus and grows to first-quarter on December 4. The moon is in Taurus when it is full on December 10, and the bright reddish star to its right is Aldebaran. On the night of the 12th, the gibbous moon is below the stars Castor and Pollux in Gemini, and on the 15th it passes above Regulus, in Leo. Last-quarter moon is in Libra on the 18th, located just above the autumnal equinox when it rises about midnight on the 17th. The waning crescent passes Mars on the 18th, Saturn and Spica on the 19th, and Jupiter on the 21st. It will be seen near them in the morning sky for several days. After new moon early on December 26, the crescent moon of the new cycle should show up in the evening sky by the night of the 28th, when it passes near Venus. Perigee moon (nearest the earth) is on December 10 and January 8; apogee moon (farthest from the earth) is on December 23 and January 20.

Stars and Planets Mars, Saturn, Spica, and Jupiter, which rise in that order from midnight on, offer a spectacular show in the morning sky, although Jupiter's motion to the east has stretched November's triangle out quite a bit. Look for these objects from about 4:00 A.M., when they should be clear of the horizon's murk, until dawn wipes them out. Note that Jupiter has now shifted well to the left of Virgo's bright star Spica, while Mars is moving swiftly toward both Saturn and Spica. Saturn, meantime, has pulled much closer to Spica, but hasn't yet passed to its left. It will pass it in early January, in late February, and again in September 1982, and then not for another thirty years. Can you guess why? I'll tell you about it in the January *Natural History*. Mercury, you may remember, was part of the Saturn, Spica, Jupiter scene last month, but it has stayed close to the sun (actually moved closer to it) while both have moved rapidly away from Virgo. On December 10, Mercury passes the sun, on the far side as seen from the earth, in the position called superior conjunction. The planet then enters the evening sky, but remains too close to the sun (setting very soon after sundown) to be seen for the rest of December and early January.

December 10: Mercury, in superior conjunction, enters the evening sky.

December 11: With perigee moon on the 10th and full moon only nine hours later on the 11th, tides should be exceptionally strong today and tonight as the effect of perigee adds to the normally stronger spring tide that accompanies syzygy twice each month (at full and new moon).

December 13–14: The normally productive Geminid meteor shower, one of the two best of the year, reaches maximum tonight. Since the full moon occurred only two nights ago, the still bright waning gibbous moon will obscure all but exceptional objects. Unfortunately, the Geminids seldom produce bright meteors.

December 16: Venus, moving closer to earth, has been brightening rapidly, but also showing less of its sunlit surface. The best balance occurs today, and Venus reaches its greatest brilliancy in our sky.

December 18–21: Watch the waning crescent moon move past the planets in our morning sky, highlighting each in turn. The moon is nearest Mars on the 18th, Saturn on the morning of the 20th, and Jupiter on the 21st. Look for them from 4:00 A.M. on, in the east.

December 21: The sun arrives at the winter solstice today, and winter begins in the Northern Hemisphere. This is also the shortest day of the year, although the earliest sunset occurred on the 9th and the latest sunrise will be about January 4.

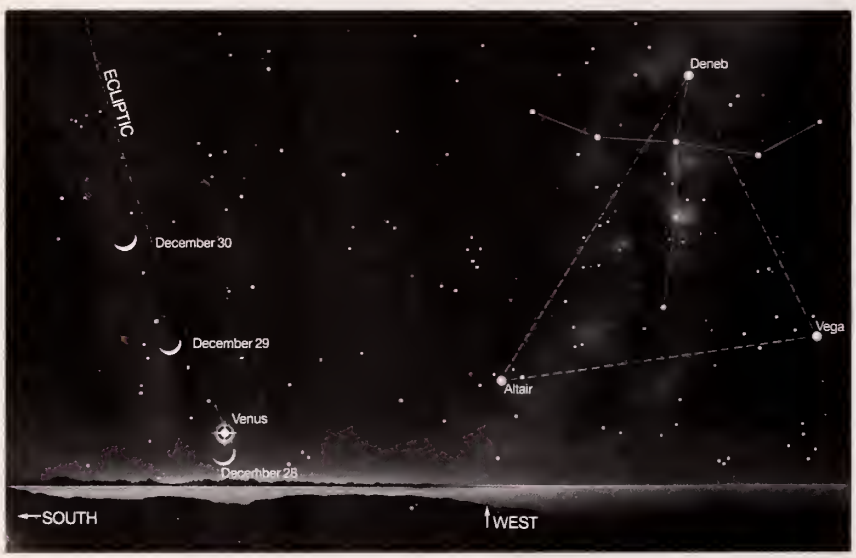
December 21–22: The Ursid meteor shower (about 15 per hour) reaches maximum after midnight.

December 28: Venus is just above the crescent moon tonight. On the 30th, the planet begins its retrograde (westerly) motion.

January 4: Earth is at perihelion, nearest to the sun (about 147,102,000 kilometers, or 91,405,000 miles, distant).

January 8: Saturn is in conjunction with Spica.

Editor's Note: The Celestial Events Sky Map in the October issue shows the evening constellations and stars for this month and gives the times for use.



Helmut Wimmer

Venus is the only bright evening planet in December, visible low in the west-southwest shortly after sundown. This hasn't been a good evening cycle for the planet, however, since it is too far south and its position relative to the sun at setting keeps it low in the sky. The view of Venus improves in late December, as its position to the sun's east brings it to the northerly curving part of the ecliptic. The early crescent moon passes above Venus on the night of the 28th, as shown here, at about 6:00 to 6:30 P.M.

Give a GIFT of NATURAL HISTORY

Give one at $15 and save 20% on subsequent gifts at $12 each

This Christmas give 12 beautiful, thought-provoking issues of Natural History to someone special. This year-long gift is appreciated by discriminating and intelligent people, and is inexpensive and easy to order. Just send this postage paid card with your order today.

☐ YES, send _____ gifts, which include 12 thought-provoking issues of Natural History and all the benefits of a one-year Associate Membership in the American Museum of Natural History. (Save 20% on all additional gifts)

J525

GIFT FROM:

Name _____

Address _____

City _____

State _____ Zip _____

☐ 1 Gift a $15 $15

☐ Additional Gifts at $12 _____
(20% savings)

Total Enclosed $ _____

☐ Payment enclosed ☐ Bill me

Charge my ☐ Visa ☐ Mastercharge
☐ American Express

Account number

Signature _____

Outside U S A please add $4 postage

GIFT TO:

Name _____

Address _____

City _____

State _____ Zip _____

Gift card to read

GIFT TO:

Name _____

Address _____

City _____

State _____ Zip _____

Gift card to read

Moneyback guarantee if not satisfied



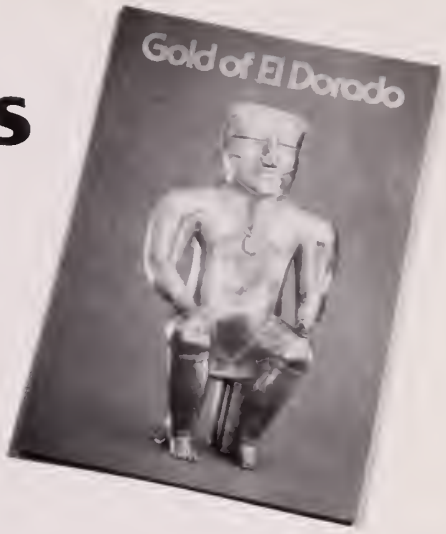
NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO 30 BERGENFIELD, N J

POSTAGE WILL BE PAID BY ADDRESSEE

Natural History
P.O. Box 4200
Bergenfield, N.J. 07621

An Art Book That Took Centuries To Create



It took the American Museum of Natural History four years to arrange its exceptional exhibition of more than 500 pieces of ancient gold from Colombia. But those few years are a brief time when compared with the decades archeologists have spent digging (literally!) and studying the gold artifacts from tombs, caves, and buried sites. And all that time is short when compared with the many centuries prehistoric Indians practiced their craftsmanship and artistry to create these treasures.

So when it became the United States sponsor for this outstanding collection, the American Museum faced a dilemma. Could we do justice to all this effort and scholarship and beauty? We think we have. First, by dramatically displaying *Gold of El Dorado: The Heritage of Colombia* in one of our largest halls. The glowing reports from visitors tell us our efforts have been worthwhile. If you don't have a chance to see the show for yourself in New York, we hope you will see it in Chicago, San Francisco, or New Orleans on its year and a half tour.

The second challenge for the American Museum was the creation of an appropriate book to accompany the exhibition. We decided against a traditional catalog; against a small, boring volume with tiny black-and-white pictures that could never do justice to these fine objects. Instead, we decided to present a select number of the finest pieces of pre-Columbian gold in a large, stunning format. And to represent the three important elements that make a great art book we chose outstanding professionals.

First, photographer Lee Boltin. One of the greatest photographers of art objects, he also took the famous pictures of the Tutankhamun show. We sent him abroad to find and record great pieces of pre-Columbian art.

Second, archeologist Warwick Bray, from the University of London. One of the world's foremost authorities on pre-Columbian art, Bray is also a skilled writer, able to present fascinating background in a succinct, readable essay in the book. Dr. Bray organized the Colombian gold exhibition in London.

Third, Harry N. Abrams, Inc., America's leading publisher of fine art books. In a co-publishing venture with the American Museum, Abrams designed the book, supervised the preparation of 30 large color plates, and monitored the fine-quality printing.

The result is an unprecedented exhibition book. It is bold and big—each plate is 16 by 11½ inches—bigger than this magazine *opened up*. The paper is heavier than most posters. In fact, many persons have purchased two copies of the book in order to have one set of these fine art prints for framing.

And now for the happy ending. Because the Museum is a co-publisher, we are able to offer this soft-bound art book at a major savings from its normal retail price of $12.50. We are pleased to offer *Gold of El Dorado* to subscribers for only $6.25—a 50% savings off its regular price. This special offer is valid only during the exhibition and only while our limited supply lasts. We suggest that you order one or more copies immediately. Of course, if you are not satisfied after you have had an opportunity to examine it in your home, simply return the book and the Museum will refund the purchase price.

Natural History Books

Gold of El Dorado Book
American Museum of Natural History
77 West 77th Street
New York, N.Y. 10024

YES, I want to purchase _____ copy/copies of the Gold of El Dorado book. I ☐ enclose payment of/☐ authorize you to charge me $6.25 per copy (plus $1.00 for shipping and handling).

My name _____

My address _____

City _____ State _____ Zip _____

For charge orders only:

Charge to: ☐ Master Charge ☐ VISA ☐ American Express ☐ Diners Club

Interbank # (Master Charge Only) [ ]

Account # (All digits) [ ]

Expiration Date _____

Signature _____
(required if using credit card)

Order

_____ book(s) @ $6.25 $____

Shipping and handling $1.00

N.Y. Sales Tax (if applicable) ____

TOTAL $____

(Make checks payable to American Museum of Natural History)

Striger, Striger, Burning Dim

by Matt Cartmill

AFTER MAN: A ZOOLOGY OF THE FUTURE, by Dougal Dixon. *St. Martin's Press, $14.95; 124 pp., illus.*

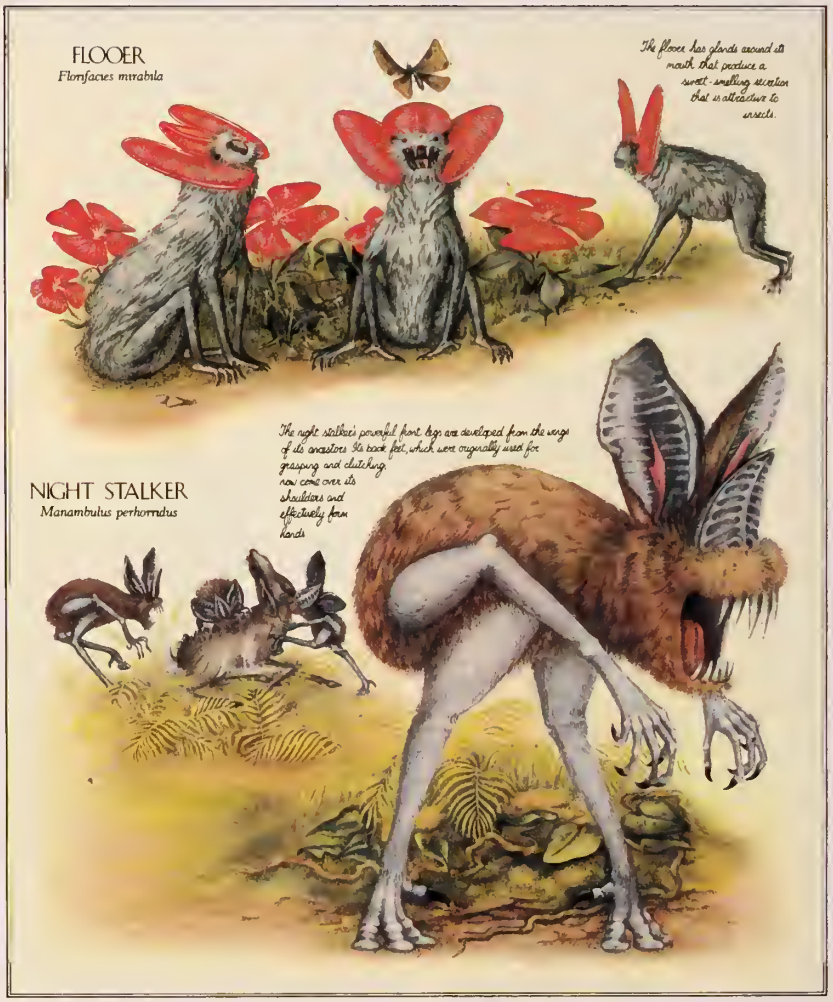
The animal I wanted
Couldn't get into the world . . .
I can hear it crying
When I sit like this apart from life.
Kenneth Patchen

Dougal Dixon wants *lots* of animals that never made it into the world. Giant killer rats with incisors like interlocking sickles. Naked pink sea lion things that swim through desert sand like dusty sharks. Big spotted bunny rabbits with the long necks and dainty hooves of gazelles. Rodent ostriches, feathered whales, blind wingless bats the size of Volkswagens: he dreams about them, draws them, sculpts them, makes up classifications and pedigrees for them. In this amusing and disturbing book, he marshals his imaginary zoo for its first parade in public.

After Man has a certain obsessive quality to it, which is one of the things that make it disturbing. God only knows what a psychoanalytic reviewer would make of it, although a few choice Freudian symbols are obvious to anyone (for example, the recurrent image of a yawning, toothy mouth set in an eyeless face). But although some of Dixon's creatures are frankly nightmarish, and the book's format and illustrations seem to be aimed at the people who buy those coffee-table books on the natural history of trolls, *After Man* is not just another dreary exercise in fantasy-world construction. It aspires to be both an imaginative entertainment and a textbook of sorts on the principles of evolutionary biology.

Dixon, a former paleontology student turned animator and pop-science writer, offers us a minutely detailed vision of what the world might look like fifty million years from now. He makes three basic assumptions. The first and simplest is that the continents are going to keep on drifting along their present courses, producing a new world map with differently arranged habitats. The second is that *Homo sapiens* is going to become extinct in the near future, when shortages of food, land, and raw materials demolish the fragile industrial economy that we all depend on (he says) for survival. The third is that most of today's large mammals—whales, elephants, cats, dogs, horses—will either be wiped out by our death throes or sucked down to oblivion along with us and our pet-food canneries. This third assumption is the critical one, because it leaves lots of empty niches waiting to be filled by the rats and rabbits and reptiles that creep out to stare at our ruins.

The book's first thirty-two pages are devoted to reality. Dixon gives us a survey of the ground rules of his evolutionary game—genetics, ecology, ethology, convergence, mimicry, Bergmann's rule, and so on—and a 6,000-word synopsis of The Story Thus Far, from the Precambrian up through the history of



Bats that have taken up a terrestrial life are the flooer, an insect-eater, and the night stalker, which devours mammals and reptiles indiscriminately.

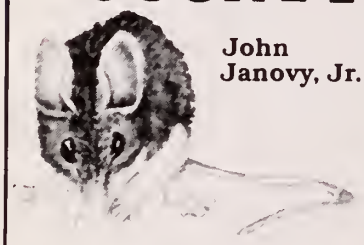
© 1980 JULIUS WILE SONS & CO IMPORTED FROM FRANCE 80 PROOF



Take another trip...

The author of *Keith County Journal* continues his elegiac observations of the diverse inhabitants of Keith County, Nebraska, including the tiger beetle, the Rocky Mountain toad, the Lonnie Paul Dinkle. As the *Boston Globe* observed of his earlier work, "This is not simply a book about nature. It is about life." Illustrated, $10.95

BACK IN KEITH COUNTY



John Janovy, Jr.

St. Martin's Press
175 Fifth Avenue, New York, N.Y. 10010



Monuments of Time

The Kawai piano is perfection obtained by the hand of time. Your investment in Kawai enhances with time.

Kawai America Corporation
24200 So. Vermont Ave., Harbor City, Calif. 90710

KAWAI

man and his well-deserved extinction. This part of the book is drably printed in black and uremic yellow on a matte paper. We turn the page and find ourselves in a four-color fantasy printed on glossy stock, full of gorgeous landscapes and delightful paintings of charmingly named animals: flapjacks, gholes, spickles, wakkas. The effect is exactly like the transition from Kansas to Oz in the old MGM *Wizard of Oz* (Dixon, remember, is a filmmaker on the side), and the subliminal message is similar: Oz, witches and all, is better than Kansas, and a fantasy world without intelligent life is better than a real world full of human beings.

This is the main reason why I found *After Man* so disturbing. For all its lovely artwork (including several witty parodies of Audubon and his successors), unflagging inventiveness, and genuine educational value, the book oozes a black misanthropy that is ultimately self-destructive. Asked in a recent television interview why he had omitted intelligent life from his zoology of the future, Dixon replied, "I take the line that Nature won't make that mistake twice." The same moral is conveyed in Dixon's book: sentience is a blind alley, and thinking leads to extinction. This sentiment seems out of place in a book that aims to teach nonscientists the principles of evolutionary biology. Telling your audience that science and learning are suicidal is a poor way to arouse their enthusiasm for learning something about science. Even on a superficial level, Dixon's zoology of the mindless future contradicts itself, for the reader soon starts to wonder just who or what is supposed to be describing these animals and giving them scientific names—in Latin, yet—if the last scientists died fifty million years before. "The purrip bat," Dixon tells us on page 46, is "so called because of its curious voice." So called by *whom*?



The pilofile's bristles extend its potential insect-catching area beyond the region of its head

SRI LANKA

The island of Serendip in the Indian Ocean better known to you as Sri Lanka or Ceylon offers you the most unexpected discoveries.

You will see in this resplendent land one of the world's oldest cultures and marvel at its ancient cities, built before Rome was founded.

Optional excursions to the architectural splendors of North & South India and the Himalayan Kingdom of Nepal; the coral formations and tropical atolls of Maldive Islands, wild life parks where you can see leopard, the rare black deer, loris, elephant and various other species of animals and birds; golden unspoiled beaches of Bentota and Trincomalee.

For brochures write to:

JOURNEYWORLD
155 East 55th St., New York, N.Y. 10022
Tel: (212) 752-8308

Natural History
Nice'n Neat



Slip your **Natural History** issues into permanent files for ready reference. Green leather-like face embossed in gold to look like fine books. It holds one year's subscription. Also for **Smithsonian**, blue, 1 year. **Audubon**, green, 1 year. **Scientific American**, red, 1 year. **National Wildlife**, blue, holds 3 years. Specify title and quantity. Postpaid.

$5.20 ea. **$4.63** ea., 3 or more

Send check or Master Charge or VISA number with exp. date, signature to

Highsmith
P.O. Box NAT 2S Ft. Atkinson WI 53538
Catalog of files free with order

For the ninth year we offer intrepid travelers the world's most challenging and rewarding tourist experience:

Greenland Dog-sledging Expeditions

MARCH 27 TO APRIL 13, 1982

Two weeks are spent on Greenland's breathtaking West Coast under the expert guidance of a leading Arctic explorer. Travel is by helicopter and husky-drawn sledges.

Detailed brochures of this expedition and a copy of our newsletter which lists all our fascinating travel programs available from

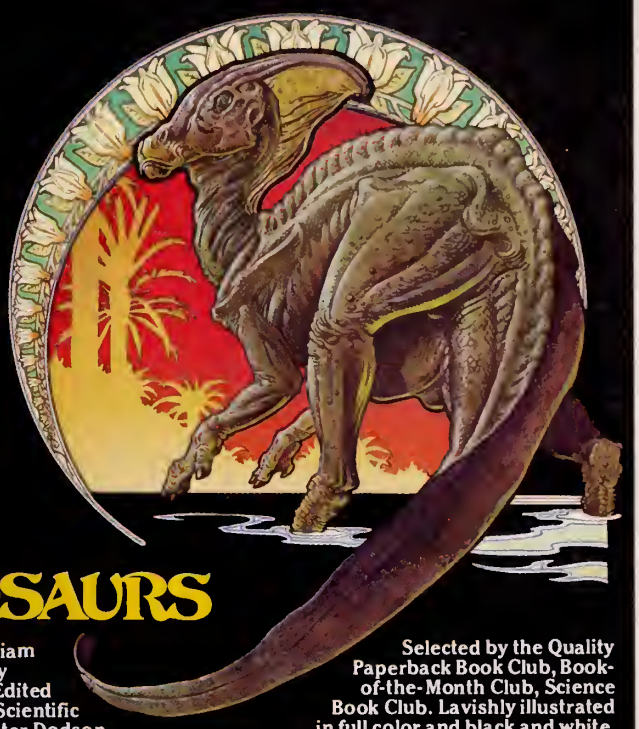
HANNS EBENSTEN TRAVEL, INC
705 WASHINGTON STREET, NEW YORK, NY 10014
TELEPHONE (212) 691 7429

Desmond Morris, in his introduction to *After Man*, compares Dixon's creations favorably to what he calls "the cheaper brands of Science Fiction." But cheap or high-priced, any competent science fiction writer knows that a world without sentient life or the hope of sentience to come makes for a boring, meaningless, and ultimately depressing story. (Compare Dixon's book with De Camp and Miller's exhilarating science fiction bonbon *Genus Homo*, which is also set in a post-human future full of giant bats and gazellified rabbits, but contains *five* plausible sorts of thinking animal—four primates and a beaver.) The human species is the only mind our planet has. Although a world without other animals would be as disturbing and repulsive as that living brain in a bottle that Orwell took to be "the logical end of mechanical progress," Dixon's fantasy world without the promise of intellect is a living body with a dead brain—futile, empty, and hopeless. And that, unfortunately, has to be the coroner's verdict on *After Man* considered simply as a work of imaginative fiction.

And as a work of scientific speculation? Considered as science, Dixon's book has real merits and equally real flaws. Both are interesting because they suggest some larger thoughts about evolutionary biology.

A lot of Dixon's imaginary animals are genuinely plausible—so plausible that it's hard to see why they should be imaginary. Take, for instance, his giant rabbits ("rabbucks") that have replaced the missing deer and buffalo. This sounds like a sure bet; rabbits and hares have convoluted guts, high-crowned teeth, and a nasty but practical habit of recycling their feces, and so they look like logical candidates for the hayburners of a future without horses and cows. Well, then why aren't there *already* rabbits the size of deer or, anyway, of small antelopes? Why haven't the rabbits ever produced a herbivore that weighed more than about fifteen pounds? Some of Dixon's other good ideas raise similar questions. Monkeys with skinfold "wings" like a flying squirrel's? Sure—but why haven't there ever been any gliding primates? Fish-eating mammals with long, many-jointed necks like a heron's or a plesiosaur's? Seems reasonable—but then why has almost every mammal for the last 150 million years or so had seven vertebrae in its neck? (A few have six; one genus of sloths has nine.) Why haven't the marsupials, some of which have been running around in trees for longer than any

The book that fleshes out the bones



THE DINOSAURS

Illustrated by William Stout. Narrated by William Service. Edited by Byron Preiss. Scientific Consultant, Dr. Peter Dodson.

Selected by the Quality Paperback Book Club, Book-of-the-Month Club, Science Book Club. Lavishly illustrated in full color and black and white.
200,000 COPY FIRST PRINTING

A BANTAM TRADE BOOK.
Bantam Books, Inc., 666 Fifth Avenue, New York 10103

The Grossman Touch



Size: 10"h x 6½"w x 6½"d
Suggested retail: $400.00

The delicacy of handmade porcelain, entirely handpainted to capture every nuance of nature's majestic beauty—this is the Grossman Touch. The Quail, skillfully modeled by Dr. William Turner, one of America's premier wildlife artists, is one piece in the collection of more than 20 sculptures produced in limited editions by the artisans of D.G. Porcelains of Virginia. See this collection today at the dealer nearest you. Or send five dollars for a full-color brochure.

The Dave Grossman Designs Touch—creating collectibles that are innovative, authentic and worthy of your taste.

Dave Grossman Designs, Inc.
Dept. 121 P.O. Box 8482
St. Louis, MO 63132

Made in America

DGD 1981

L.L.Bean®

Outdoor Sporting Specialties



FREE Winter Catalog

72 pages of cold weather favorites from L.L. Bean. Quality apparel and footwear for men, women and children. Snowshoeing, cross country skiing and hiking gear. Wood burning accessories. Casual home furnishings. Many items of our own manufacture. All fully guaranteed. Our 69th year of providing dependable outdoor sporting specialties.

☐ Please send FREE Winter Catalog

Name_____

Address_____

City_____

State_____ Zip_____

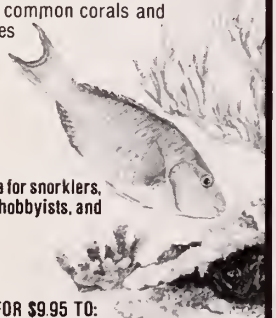
L. L. Bean, Inc.
782 Casco St., Freeport, ME 04033

Handguide to the

CORAL REEF FISHES...

Makes Your Visit to the Caribbean More Fun than Ever

- More than twice as many species (460) as any other guide
- Organized for easier, faster, more accurate identification
- Remarkably accurate full color illustrations in natural habitat
- Covers all Caribbean waters as well as Florida, Bermuda and the Bahamas
- Crammed full of interesting information
- Includes 50 common corals and invertebrates



- **Great gift idea for snorklers, sportdivers, hobbyists, and vacationers**

SEND CHECK FOR $9.95 TO:
ACADEMY OF NATURAL SCIENCES
Publications Department — Fish Guide
19th and the Parkway • PHILA., PA 19103 USA
PA. residents add 60¢ copy sales tax.

The tree goose or hanging bird in roosting position



placental mammals have, ever come up with an imitation monkey like Dixon's "baraboo" when they've had no trouble evolving imitation dogs, moles, woodchucks, and flying squirrels?

One answer might be to point to the important role of chance in evolution. Maybe there aren't any giant rabbits because there just don't happen to be any giant rabbits, and no more need be said. But I suspect that there is more to it than that, and that we simply don't yet understand the reasons why evolution has missed so many apparently good bets. Some important facts about ecology, genetics, or the general principles of evolutionary change may be escaping us because we are busy trying to figure out why we have the animals we have, not why some animals can't get into the world. Maybe there are genetic or embryological reasons that prohibit marsupials from having big brains or mammals in general from having a dozen cervical vertebrae. Maybe there are fundamental ecological reasons for the absence of rabbucks. Perhaps there is some global truth about primate locomotion that explains why no monkeys ever took to the air. If so, then we need to start thinking seriously about the zoology of imaginary animals, and *After Man* is a good enough place to start.

Unfortunately, most of Dixon's animals aren't very instructive. They don't exist because they're anatomically, ecologically, or evolutionarily absurd. Take the purrip bat, for instance. Not only is it eyeless (a favorite assumption of Dixon's, even for tree dwellers and open-country predators), but it has its ears shoved forward to the tip of its snout, a move guaranteed to eliminate the phase differences between right and left ears needed for echolocation. Presumably it runs into things a lot. The lost carnivores

In 1974 we originated our epoch-making **Galapagos Islands Thrift Cruises**, *which for several years enabled many hundreds of budget-minded travelers who were interested in ecology, wildlife and photography to see these unique islands without luxurious trimmings but under expert guidance.*

We now again offer a budget program which includes some of the highlights which make a visit to this remarkable archipelago such a renowned tourist attraction. We explore five of the islands in order to view sea lions, iguanas and a large variety of birds, such as the famous Darwin's finches, boobies, frigates and gulls.

Galapagos Islands Thrift Program

APRIL 4 TO 14, 1982
JUNE 27 TO JULY 7, 1982
DECEMBER 26 TO JANUARY 5, 1983

Our program includes easy hikes on Santa Cruz to see tortoises roaming free and to the top of the dormant volcano at Sullivan Bay, and ample opportunities for swimming and snorkeling. It is ideal for young people and families with children and has been planned during periods of school and college vacations.

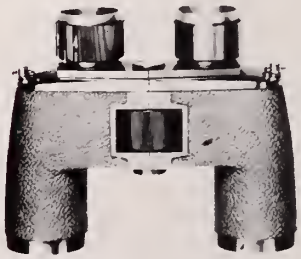
We do not claim that these programs are as comprehensive as our superb and unrivalled **Discover Galapagos** yacht cruises in August and October, 1982; but our meticulously supervised arrangements do provide you with a fascinating introduction to these wonderful islands—and at a third of the cost.

Each program is accompanied by one of our expert leaders and a naturalist guide who give informative talks and lead us in the field.

Before the week at the islands, we spend two days at the best hotel in Quito, Ecuador's lovely capital in the Andes.

Please send for the detailed brochure of these programs—we also specialize in expeditions to Greenland, Mount Kilimanjaro, the Himalayas and the Andes; wildlife safaris to see polar bears and seals in northern Canada and to Scotland, Borneo and Rajasthan; and archaeological tours to Peru, Morocco and Egypt.

HANNS EBENSTEN TRAVEL, INC
705 WASHINGTON STREET, NEW YORK, NY 10014
TELEPHONE (212) 691 7429



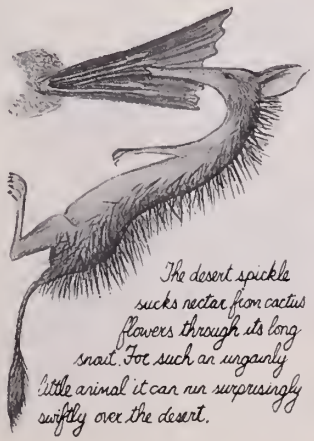
BUSHNELL 7x35 CUSTOM
Mfg. List $280.00 **Postpaid $164.00**

This is an example of the deep discount prices on high quality optics that is found in our FREE catalog. This catalog lists and illustrates an outstanding selection of telescopes, binoculars etc., plus valuable information on how to properly select them. Write for it today.

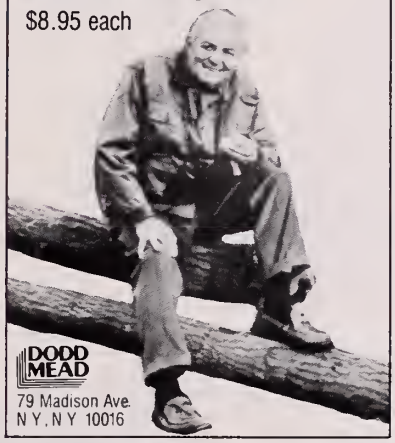
GIL HEBARD OPTICS
COURTHOUSE SQ., KNOXVILLE, ILL. 61448

of Dixon's Africa have been replaced by various species of meat-eating monkeys ("raboons"), which have "increased their speed by taking to their hindlimbs and adopting a totally bipedal locomotion." Anyone who thinks that bipedal primates are speedier than quadrupeds might find it instructive to try chasing an alley cat. On page 92, Dixon solemnly informs us that his "zarander" (a pig practicing to be an elephant) "like other mammals of the forest floor . . . has little sense of smell." This suggests that Dixon has never watched a coati or an opossum—or, for that matter, a pig. Even when Dixon has a good idea, he generally manages to spoil it with a mistaken pontification or an anatomical gaffe. For example, take a look at the drawing of the "falanx" reproduced on the following page. The incisors of this rat in wolf 's clothing are an inspired invention; they wrap up the stabbing canines and shearing premolars of a real carnivore into a single neat dental mechanism. But the drawing of the skull is an anatomical joke. It's obviously the skull of a herbivore, with a hopelessly addled jaw joint and ear region. My guess is that it was copied from a picture of a deer skull by an artist who didn't understand what he was looking at. This isn't Dixon's doing (his own drawings of the falanx, reproduced at the beginning of the book, are much better), but it's his fault for not fixing it.

I could go on for a dozen pages poking holes in Dixon's fabrications—especially if I let myself get started on his eyeless marsupial sloth that traps bugs by drooling into flowers—but that would give the wrong impression. Many of Dixon's evolutionary inventions are excellent, and the ones that are silly are generally silly enough or scary enough to be fun. As a piece of prediction, *After Man* is a nonstarter, but it's still an



Always in season...
THE AMERICAN SEASONS SERIES
by Edwin Way Teale
These four classics—by one of America's great literary naturalists and winner of the Pulitzer Prize—are now available in Dodd,Mead Quality Paperback:
North With the Spring
Journey Into Summer
Autumn Across America
Wandering Through Winter
$8.95 each



DODD MEAD
79 Madison Ave.
N Y, N Y 10016

Share the Thrills of Exploring Outer Space!



$359.95 f.o.b. Hartford, Conn.

Now it's easy to join the thousands of serious amateurs who have discovered the excitement of exploring our mysterious universe. Your enjoyment begins right from the start, yet the challenges and rewards go on for years! And it's a hobby that can be shared at modest cost.

Choose From Many DYNASCOPES®

Picking a telescope to fit your needs and your pocketbook is simple when you select a DYNASCOPE—the same instruments used by more than 150 schools, colleges and observatories—and your satisfaction is guaranteed by a full-refund warranty.

FASCINATING GUIDE YOURS FREE!

Read these valuable facts before buying any telescope. Mail coupon or postcard for your complimentary copy of this helpful guide.



Criterion Manufacturing Co.
620 Oakwood Ave., W. Hartford, Conn. 06110

® TM Registered U.S. Pat. Office

CRITERION MANUFACTURING CO., Dept NH 110
620 Oakwood Avenue., W. Hartford, Conn. 06110
Please send your free Telescope Guide.
Name_____
Address_____
City_____ State_____

Stargazing–with the great minds of history

From the astronomy of the ancient Greeks to our own physical exploration of space, man's preoccupation with the cosmos has dramatically influenced both our culture and values. In a skillful blend of science and biography, noted historian Vincent Cronin brings alive the cosmology of each age through its key figures. The result is a lively and thorough analysis of man's fascination with the universe—from the days of Pythagoras and Plato to the making of *Star Wars*.



$15.00
William Morrow
105 Madison Ave., NY, NY 10016

AUTHORS WANTED BY NEW YORK PUBLISHER

Leading subsidy book publisher seeks manuscripts of all types: fiction, non-fiction, poetry, scholarly and juvenile works, etc. New authors welcomed. Send for free, illustrated 40-page brochure W-82 Vantage Press, 516 W. 34 St., New York, N.Y. 10001

Wildlife Tours



Whale Watching in Mexico, Hawaii and Canada

Wildlife safaris Tanzania, Kenya, Botswana

Gorilla viewing Rwanda

many other trips

Travel with the experts

Adventures International
4421-N Albert St., Oakland, CA
(415) 531-6564

SPECTACULAR!



THE 1982 LUNAR PHASE POSTER/CALENDAR

The elegance of the moon's natural cycle displayed in a giant splash of color. Each day's astronomically correct phase is keyed to the date and day of the week. Detailed silver crescents provide fascinating patterns on the dark blue "sky."

Your 16" × 37" graphic comes rolled in an attractive Gift Tube—just add a bow! We guarantee that your friends will want one.

PROMPT FIRST CLASS SHIPMENT $5.75 ppd each; 2 or more—$5.00 ppd each. Discount gift list order form and information on request. Check, VISA, MASTERCARD. Send Name, Address, Account #, Exp. date to:

CELESTIAL PRODUCTS, INC.
Dept. NH, 10 W. Washington Street
Middleburg, Virginia 22117-0801

In the spring and fall of 1982 we repeat our popular program for travelers who enjoy outdoor things

Naturalist's Tour of the Scottish Highlands

MAY AND SEPTEMBER, 1982

We stay at small country inns and, by special permission, on the island of Rhum in the Inner Hebrides. We hike across moors, through forests and in unspoiled mountains among alpine flowers, sample local dishes and fine whisky, meet Highland people and listen to the sound of bagpipes.

Detailed brochures of this tour and a copy of our newsletter which lists all our fascinating travel programs, available from:

HANNS EBENSTEN TRAVEL, INC
705 WASHINGTON STREET, NEW YORK, NY 10014
TELEPHONE (212) 691 7429

entertaining bestiary. Why bother swatting Dixon's butterflies with a meat-ax? Well, in this case, swatting a few is instructive for two reasons: first, because the book's obsessively detailed fantasy is disguised as the product of scientific reasoning, and it's worth pointing out the difference; and second, because annotating the flaws in *After Man* has left me feeling a renewed confidence in the scientific status of evolutionary biology.

Evolutionary biology is in a dreadful funk at the moment. Some prefer to call it a scientific revolution, but "funk"—a state of depression and cowardice—seems like a more accurate description. Every learned journal and scientific meeting is sprinkled with papers bemoaning the shortcomings of Darwinists and telling us what we must do to be saved. One after another, Jeremiahs and iconoclasts are leaping onto their soapboxes and accusing their fellow evolutionary biologists of circular reasoning, hollow explanations, baseless assumptions, and general all-around mushheadedness. Some of these accusations have some real sting to them, but the cures being peddled along with them—genetics based on French anthropology, systematics rooted in Viennese philosophy, dialectical paleontology, and the like—are mere Laetrile. Hence the funk.

Reading *After Man* with a critical eye helps to dispel that funk. I feel dead certain that Dixon's raboons and purrip bats and sand sharks are not going to evolve in any world that might follow the extermination of man. I don't believe in his clawed armor-plated apes ("khiffahs") that weave huge, communal nests in the treetops and feed on

The falanx, one of the earth's principal carnivores, is a large doglike rat that preys on the herbivores of the plains and forests.



roots (!) and berries. I don't believe in the "strigers"—brachiating cats with opposable thumbs—that prey on the khiffahs. I can't believe for an instant that all the dogs, cats, foxes, goats, rabbits, and other Eurasian mammals that have been introduced to Australia over the last two centuries are going to step politely aside and allow the native marsupials to have a big evolutionary radiation (especially one featuring pouched monkeys and blind, slobbering sloths) in the next fifty million years, even if *Homo sapiens* is out of the picture. I'm not only sure that these products of Dixon's imagination *won't* happen (after all, the odds are a zillion to one against any detailed prediction about the distant future); I have some empirical and theoretical reasons for being fairly confident that they *can't* happen. And having such reasons is heartening because (unless I am just deluded) it means that evolutionary biology has enough predictive power to rule out a vast number of seemingly possible futures and that we probably understand evolution a good deal better than some of us are willing to admit.

Does this make evolutionary biology a real hard-core predictive science? Yes and no, but mostly no. For example, I'm willing to predict that if people become extinct and Australian marsupials don't, there will be animals in Australia ten million years later descended from domestic cats. Testing this prediction, however, is a bit sticky; the conditions of the experiment presuppose that no one is left to note the results. And this dismal presupposition is crucial to any sort of long-term evolutionary prediction. As long as *Homo sapiens* is running around disseminating diseases and poisons and edible garbage and foreign animals in all directions, turning forests into deserts and deserts into suburbs, and generally altering the environment in massive and unpredictable ways too fast for the process of adaptation to catch up, all bets are off about the future of terrestrial life in the long run. This is why Dixon's book has to begin by killing off its author and his audience. Beginning with that premise, you might concoct a more inventive or more plausible fantasy than *After Man*, but you can't develop a science that presupposes the absence of scientists. A predictive science of macroevolution is a contradiction in terms.

Matt Cartmill is professor of anatomy and associate professor of anthropology at Duke University.

"A brilliant series of answers." —*TIME*

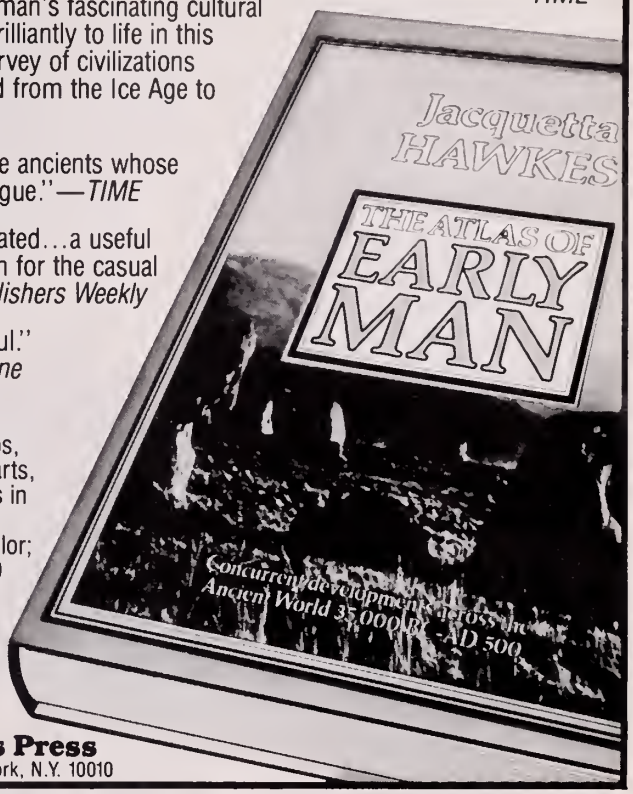
The richness of man's fascinating cultural history comes brilliantly to life in this extraordinary survey of civilizations around the world from the Ice Age to the fall of Rome.

"A chart of all the ancients whose past is our prologue."—*TIME*

"Superbly illustrated...a useful reference and fun for the casual browser."—*Publishers Weekly*

"Big and beautiful."
—*Chicago Tribune Book World*

Photographs, maps, drawings, and charts, including 64 pages in two color and 64 pages in full color; 8½" x 11"; $25.00



St. Martin's Press
175 Fifth Ave., New York, N.Y. 10010



THE MUSEUM SHOP

For your holiday gift giving, remember the Museum Shop. You can visit us or mail this coupon for a new fall catalog.

American Museum of Natural History
Museum Shop Catalog, Department NH
CPW at 79th St.
New York, N.Y. 10024

Name _____

Address _____

City _____

State _____ Zip _____



Merry Christmas from all of us at Jack Daniel's

Jack Daniel Distillery, Lem Motlow, Prop., Inc.,
Route 1, Lynchburg (Pop. 361), Tennessee 37352

Additional Reading

Humpback Whales (p. 30)

General books on whales containing information about humpbacks include: *Whales, Dolphins, and Porpoises*, edited by K. Norris (Berkeley: University of California Press, 1977); *The Year of the Whale*, by V.B. Scheffer (New York: Charles Scribner's Sons, 1969), which has an annotated bibliography; *The Whale: Mighty Monarch of the Sea*, by J.Y. Cousteau and P. Diole, translated from the French by J.F. Bernard (Garden City: Doubleday and Co., 1972); *The Great Whales*, by F. McNulty (Garden City: Doubleday and Co., 1974); and *The Book of Whales*, written and illustrated by R. Ellis (New York: Alfred A. Knopf, 1980). The January 1979 issue of *National Geographic* contains two articles on humpback whales. Marine biologist S.A. Earle recounts her observations from a research project on humpbacks in Hawaii in "Humpbacks: The Gentle Giants" (pp. 2–17), with photographs by A. Giddins. Interested in humpbacks as "floating islands of the sea," Earle set out to observe the whales in their own realm and went on various swimming expeditions with them. Zoologist R. Payne, who studied the complex songs of the humpbacks for twelve years, suggests their sound sequences may relate to social behavior and possibly to intelligence in "The Mysterious Songs" (pp. 18–25). The issue also contains "Songs of the Humpback Whale," an accompanying, detachable sound sheet reproducing some of the whale songs. Longer samples of humpback whale songs are available on two albums released by Capitol Records, *Songs of the Humpback Whale* (SW-60) and *Deep Voices* (ST-11598). *Natural History's* last arti-

cle on these mammals was "The Humpback Is Not Over the Hump," by J. Lien and B. Merdsoy (June–July 1979).

Wasps (p. 36)

H.E. Evans and M.J. Eberhard discuss the thynnine wasps briefly in their detailed, readable introductory paperback *The Wasps* (Ann Arbor: University of Michigan Press, 1970). There is much evidence that sperm competition is common in insects as a result of multiple matings. G.A. Parker analyzes the importance of sperm competition—which he defines as "the competition within a single female between the sperm from two or more males over the fertilization of the ova"—in his article "Sperm Competition and its Evolutionary Consequences in the Insects" (*Biological Reviews*, vol. 45, pp. 525–68). Parker explains how sexually selected adaptations that occur in response to the preadaptation of insects to sustaining a very high level of sperm competition have led to intense intrasexual pressures on the male. R. Thornhill presents the theoretical aspects of gift giving in male insects and explains the different types of nutritional paternal investment during reproduction in "Sexual Selection and Paternal Investment in Insects" (*American Naturalist*, vol. 110, pp. 153–63). "Daddy Water Bugs," with text and photographs by R.L. Smith (*Natural History*, February 1980, pp. 56–63), examines the unusual reproductive behavior of many species of giant water bugs in which the male carries and cares for the eggs.

Proteaceae (p. 42)

A. Huxley's *Plant and Planet* (New York: The Viking Press, 1975) begins with an account of plant evolution, briefly describes the major plant groups, then provides chapters on photosynthesis, structure and growth, and other aspects of plant life. The final five chapters deal with human exploitation and manipulation of plants. Illustrated with engravings, Huxley's work is readable and accurate; he uses colloquial plant names whenever possible and offers a good bibliography. *Structure, Form, Movement*, by H. Hertel, translated from the German by Scripta Technica, Inc. (New York: Rheingold Publishing Corporation, 1966), explores the relationship between biology and engineering, proposing that a closer partnership between the two fields would be mutually beneficial. Two other works relevant to "Protean Beauty" are *Art Forms from Plant Life*, by W.M. Harlow (New York: Dover Publications, 1974), and *Seed Biology*, edited by T.T. Kozlowski (New York: Academic Press, 1972).

Spacesuits (p. 50)

Suiting Up for Space, by journalist L. Millan (New York: The John Day Co., 1971), is a nontechnical, illustrated account tracing the development of the spacesuit. Beginning with the early suit designed for Mark Ridge by J.B.S. Haldane and Sir Robert Davis, the book then discusses the evolution of different spacesuits, ranging from the primitive suit fashioned for American daredevil Wiley Post to the multilayered Apollo life-support system. A.C. Guyton's *Textbook of Medical Physiology* (Philadelphia: W.B. Saunders Co., 1976) is a standard reference that gives some information on the physiological problems experienced at high altitudes; the section on aviation medicine, "Aviation, Space, and Deep-Sea Diving Physiology," is especially relevant to this issue's article on spacesuits. There are a number of Scientific Technical Aerospace Reports published by NASA offering technical but readable information on life-support systems and the physiological problems experienced in outer space. A collection of twenty-seven papers from a symposium, *The Second Conference on Portable Life-Support Systems* (Washington, D.C.: National Aeronautics and Space Administration Special Publication No. 302, 1971) is available from the National Technical Information Service, Springfield, Virginia 22151. For more physiological information, see *The Bioastronautics Data Book*, edited by J.F. Parker and V.R. West (Washington, D.C.: National Aeronautics and Space Administration Special Publication No. 3006, 1973). *Advanced Extravehicular Protective System (AEPS) Study*, edited by J.L. Williams, B.W. Webbon, and R.J. Copeland (Dallas: Vought Missile and Space Co., National Aeronautics and Space Administration Contractor Report No. 114382, 1972), is a readable, detailed account summarizing a study of life-support systems of the future. *Biomedical Results of Apollo*, edited by R.S. Johnson, L.F. Dietlein, and C.A. Berry (Washington, D.C.: Scientific and Technical Information Office, National Aeronautics and Space Administration, 1975), covers the different medical problems associated with people in space and provides information on life-support systems. It is available for sale from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Rita Campon

Endangered Pisces

The Great Lakes whitefish is exploited by both lampreys and humans

by Raymond Sokolov

When my father's father came to this country just after the turn of the century in the great wave of Jewish immigration from Eastern Europe, he did his greenhorn best to make a clean break and adapt to America. He struck out for the last frontier and made a quixotic stab at homesteading on bone-dry land in southern Utah. Cutting his losses after two years, he retreated back East during World War I and resettled in Detroit, where he had cousins and where, after so much unaccustomed mountain landscape and exotic brushes with Mormons and coyotes, he found the familiar comforts of urban life as well as a familiar fish.

In Detroit, as in any Great Lakes town of that period, whitefish abounded. This fleshy, mild-tasting relative of the salmon and the trout, known to ichthyologists as *Coregonus clupeaformis*, has many cousins in Europe, especially in the Russian empire my grandfather had escaped. There, the whitefish Linnaeus dubbed *C. lavaretus* was called *sig*, and Jewish families knew it best either smoked or ground up and poached in those quenellelike fish dumplings called gefilte fish.

The Great Lakes whitefish was not only a perfect substitute for the European, but it also grew on an American scale, averaging four pounds and occasionally breaking twenty. My grandmother, when I first knew her in the forties, was still continuing the old *shtetl* tradition of chopping whitefish for gefilte fish. Like other Jewish grandmothers, she tasted the raw fish paste as she worked, correcting the seasoning, and thereby risking the tapeworms that might have lurked in the mixture.

By then, my grandfather had professionalized his ancestral ties with whitefish; he ran a small fish market in Detroit. In our family, then, whitefish seemed like a very routine part of everyday life. Smoked whitefish for Sunday brunch, gefilte fish on holidays, and insidiously bony whitefish fillets sprinkled with paprika and broiled for dinner all seemed to me unremarkable features of growing up in the Great Lakes region. Cod was strange, lobster virtually unavailable, but whitefish was a staple.

All the while, doom was slithering toward us in the jawless, primordial form of the sea lamprey. These eellike creatures (*Petromyzon marinus*) are grotesque, with their single nostril, their fourteen gill holes, and their toothy, suctorial mouth pad. Lacking a central nervous system and endowed with a cartilaginous spine, they are not, in fact, eels (which are structurally more advanced and belong to the true or bony fishes, Osteichthyes). Along with the hagfish—similar members of the Agnatha class—lampreys are considered to be the oldest surviving vertebrates.

Ugly and nightmarish, the lamprey incubates peacefully enough for several years in streams, but then it enters its parasitic stage, propels its twenty-inch-long form into deeper water, and hunts for prey. Vampires of the aquatic world, lampreys attach their suctorial mouth to other fish. With their teeth, they rasp away at the victim's flesh, then drink its blood; their saliva contains an anticoagulant that thins blood and makes it easy for them to suck a whitefish dry.

Lampreys did not originally infest the Great Lakes. They were let in by the building of the New York State Barge Canal and the Welland Canal, which my other grandfather worked on as an engineer. The *coup de grâce* came when a thoroughfare for lampreys was inadvertently made by the construction of the Saint Lawrence Seaway. In the wake of the great seagoing vessels that began to ply the new water route to Lake Superior and Lake Michigan after World War II, *P. marinus* sinuously followed.

In other countries, such as France, the solution to the lamprey plague would have been obvious: eat them. Lamprey cooked in the style of Bordeaux (see recipe) is a classic dish, so



The Greak Lakes whitefish, Coregonus clupeaformis, *was abundant until the 1950s when sea lampreys nearly destroyed the population.*

Photographs by Adelaide de Menil

DEVELOP YOURSELF.

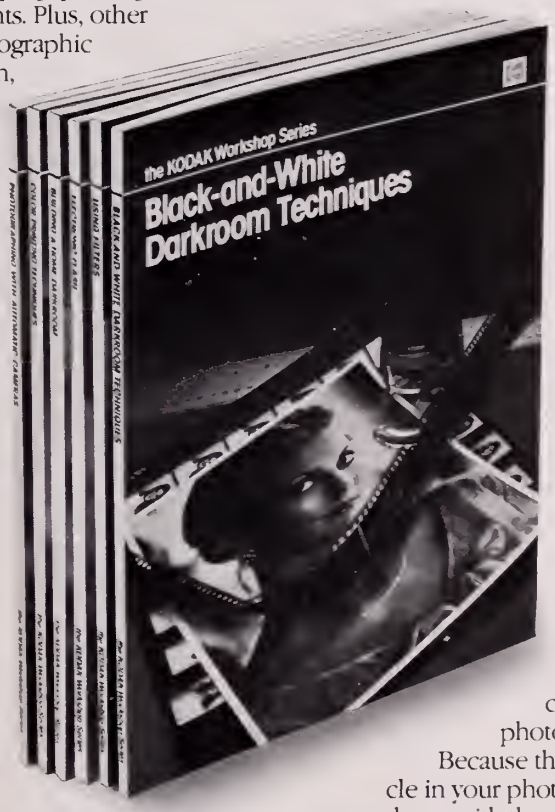
Pick your area of interest. And *teach yourself* with six easy-to-follow books in the new *KODAK Workshop Series.*

Each volume contains 96 pages of step-by-step pictorial instructions and costs only $8.95.

Black-and-White Darkroom Techniques details all the steps for developing, printing, and finishing black-and-white prints. Plus, other sections cover choosing photographic paper, dodging and burning in, mounting prints, and more.

Using Filters gives creative advice that helps you see and capture extraordinary images in color and black-and-white. It shows you how to create mood with color filters, add dazzle with special-effects filters, and render more natural colors and tones with correction filters.

Photographing with Automatic Cameras shows you how to get the most from your automatic camera. Especially useful for newcomers to 35 mm photography, it looks at how automatic cameras work and how to best use one. It offers special tips for capturing landscapes, portraits, and other subjects with an automatic camera.



Building a Home Darkroom tells you how to plan, what you'll need, and where to locate. From planning to construction to electrical work to plumbing, this book shows the step-by-step completion of a prototype darkroom in photographs and easy-to-understand illustrations.

Electronic Flash starts with the basics, giving thorough coverage of how, when, and where a flash can be used to enhance your photographs. Advanced techniques such as bounce and multiple flash are discussed.

Color Printing Techniques explains the basic procedures for making color prints from color negatives and color slides (including the new KODAK EKTAFLEX PCT Color Printmaking Products). Also included is information on equipment, darkrooms, retouching, and framing.

Choose one or all six titles in the new *KODAK Workshop Series* at your camera store or wherever fine photography books are sold.

Because the best way to put some muscle in your photographic development is to work out with the experts.

When it comes to photography, Kodak wrote the book.

Kodak

© Eastman Kodak Company, 1981



popular it is even canned. In Finland, lampreys are smoked. Portugal, too, is a center of lamprey fishing. England once also favored the lamprey, but by 1850, interest in it had largely died out. Given the arduous and slightly macabre procedure (scalding, bleeding, and beheading) required to prepare the lamprey, it is not hard to see why it might scare off home cooks. Still, it could be easily cooked in a professional or factory setting, and it seems a shame that this vaunted delicacy was not actively promoted as a food source in this country when it suddenly became so plentiful. Instead, it was attacked as a useless vermin.

By the mid-fifties, sea lampreys had nearly destroyed the whitefish population of Lake Michigan (as well as that of the lake trout). The commercial catch fell below 100,000 pounds. Then a solution was found: a poison, called TFM, that kills lampreys selectively in the streams where they spawn. Since 1962, a joint United States-Canadian control program has effectively suppressed lampreys and largely protected other fish. The proof of this has been a dramatic rebound in the whitefish population. Commercial production from Lake Michigan rose to a recent peak of one million pounds.

Fish, however, are never simple. Last year, the Lake Michigan harvest sank to 800,000 pounds. Ron Poff, a fish expert with the Wisconsin Department of Natural Resources, blames the decline on "overexploitation of the whitefish population." The whitefish have responded to the pressure by maturing faster, he says, but they can only take so much.

Poff represents only one of the many groups that care intensely about whitefish in Lake Michigan. The state of Michigan bears an equal legal responsibility for the lake. It differs officially with Wisconsin over the respective conservational merits of gill netting versus trap netting. Commercial fishermen have their points of view. Tribal Indians fish the same waters under a separate set of rules and privileges. Meanwhile, the ordinary consumer, given half a chance, will eat fresh whitefish again and again with insatiable zest. And as long as there is whitefish to catch in Lake Michigan, people will throng to Door County, Wisconsin, to feast on whitefish at a traditional Wisconsin fish boil.

There are plenty of other reasons to visit Door County in the summer. The end of a big peninsula stretching out into Lake Michigan, it is a rural paradise of Holstein cows and cornfields and cherry orchards with a water view, all only an hour's drive from gritty Green Bay. On my way through the county last summer, I stopped to pick a bucket of tart pie cherries at one of the commercial orchards that invite amateurs in to pick what they need for a modest price. Special folding wooden ladders planted in the sandy soil permit the picker to reach whatever point in the tree he wants. Large families were contentedly filling long strings of buckets.

In Sturgeon Bay, I bought smoked whitefish for $2.75 a pound at a market that does its own smoking out back over maple, imparting a mild flavor to the fish's flesh, which is more delicate than the smoking done for shipping to New York deli counters.

In the resort village of Fish Creek, I headed for Jan and Andy Coulson's White Gull Inn, a white clapboard building dating back to 1896, which has landmark status in Wisconsin. There I sat down on the patio in back to watch Russ Ostrand preside over the best-known fish boil in the county.

Russ is a big, warm fellow who works in a shipyard in Sturgeon Bay and literally moonlights as a chef and strolling accordionist at outdoor banquets. In the winter, he runs coon feeds and venison feeds for hunters and civic groups. But in the summer, on Wednesdays and weekend nights, he concentrates on fish boils and gives hundreds of tourists a taste of what life was like in the old Wisconsin lumber camps where fish boils began.

The method is simple, quick, and requires nothing more than an ample



At a Wisconsin fish boil, left, Russ Ostrand adds potatoes to a caldron of boiling water. Meanwhile, guests at the White Gull Inn, right, wait for the thick whitefish steaks to be added and the meal to begin.

supply of fish, potatoes, salt, hardwood, and a big pot. At the logging camps, it was the ideal way to get dinner together for a mob of ravenous lumberjacks.

Ostrand starts by building a large wood fire from logs of oak, maple, cherry, and beech. On a metal stand sits a twenty-two-gallon caldron filled with twenty gallons of lightly salted water. In that pot, Ostrand first cooks red Wisconsin potatoes. He lowers them into the water with a perforated metal basket whose handle will later permit him to extract the potatoes from the pot. In an evening, he will boil forty pounds of potatoes for eighty people, and eighty pounds of whitefish, cleaned and cut into thick steaks. The only trick is timing. It takes just a few minutes to cook the fish.

When it's ready, Ostrand gingerly tosses a coffee can of kerosene into the fire, which surges up in twenty-foot flames. The conflagration is spectacular, but it also has a practical point. It makes the pot boil over, thus purifying the fish of any scum and oil that have come to the top of the pot during cooking. Then, out comes the fish, ready to be eaten in one of the greatest fast-food banquets ever devised.

Raymond Sokolov's new book, Fading Feasts *(Farrar, Straus and Giroux), is a collection of food columns that first appeared in* Natural History.

Eve Hecht's Gefilte Fish

2 pounds whitefish
2 pounds yellow pike
1 pound carp
3 medium onions
4 tablespoons salt
3 tablespoons sugar
3 eggs, lightly beaten
2 tablespoons matzo meal
Pepper
3–4 carrots, scraped and cut in rounds

1. Have your fish man fillet the fish. Take the bones and fish heads with you. And try to get an extra head—it will improve the broth.
2. Grind the fish with two of the onions, coarsely, in a meat grinder or a food processor.
3. Transfer to a wooden bowl and continue chopping with a mezzaluna (a half-moon–shaped chopper) as you work in two tablespoons salt, one tablespoon sugar, the eggs, the matzo meal, and enough water (about ¼ cup) to produce a smooth, light paste. Set aside.
4. Put the fish heads and bones as well as the remaining salt, and sugar, pepper, carrots, and the remaining onion (peeled and sliced) into a large pot of wide diameter. Cover these ingredients generously with water and bring to a boil. In a separate pot, bring three quarts of water to a boil.
5. When the first pot comes to a boil, begin making the fish balls. Keeping your hands moist with cold water, form spheres roughly the bulk of a jumbo egg (they will expand when cooked) and drop them, one by one, into the pot with the fish bones. The water should be kept at a slow simmer as you continue to add fish balls. When the paste has been completely used up, continue simmering for about 1½ hours. Add additional boiling water from the second pot as necessary, so that there is enough to float the balls.
6. Remove from heat and let the fish balls cool in cooking liquid.
7. Remove the fish balls to a serving platter.
8. Strain the cooking liquid. Pour it into a jar and refrigerate. It should gel. If it does not, rewarm the liquid and dissolve a package of gelatine into it. Test the sauce by putting a teaspoon of it on a saucer in the refrigerator: If the liquid does not gel, add more gelatine and continue until it does. Refrigerate.
9. Serve fish balls with gelled fish aspic and horseradish.

Yield: 8–10 servings

Lamprey Bordelaise

(Adapted from Raymond Oliver's *La Cuisine*)

1 live 2-pound lamprey
1 cup sauterne or other sweet white wine
6 tablespoons olive oil
8 leeks, cut into green and white parts, well washed, and sliced into 5-inch strips
3 medium onions, peeled and chopped
8 cloves garlic, minced
4 shallots, minced
2 carrots, scraped and diced
4 celery hearts, sliced
2 tablespoons flour
3 cups dry red wine
1 sprig parsley
1 bay leaf
¼ teaspoon dried thyme
¼ pound smoked ham or prosciutto
Black pepper
Salt
2 tablespoons butter
¼ cup Armagnac

1. Put the lamprey into a rough wooden box with no lid. Pour a slow stream of very hot but not boiling water over the lamprey, which will squirm and, in so doing, scrape off the film that covers its skin. Do not scald the lamprey to death. As soon as it has been doused on all sides, pour on cold water to revive it and scrape off any remaining film with a knife.
2. Tie a string around the lamprey's neck and suspend it from a hook over a saucepan containing the sauterne. Cut off six inches of the lamprey's tail (reserving this piece) and let the fish bleed into the wine, stirring constantly until the bleeding is complete and the mixture is well blended.
3. Make several vertical incisions just below the cartilaginous backbone and pull it out in one piece. Cut off the head and discard. Cut the body into six or eight even slices. Remove the gut and discard.
4. Marinate the pieces in the blood-wine mixture for three hours.
5. Preheat oven to 300 degrees.
6. Heat four tablespoons of the oil in a saucepan and cook the onion, garlic, shallot, carrot, celery, and the green parts of the leek until soft. Stir in the flour, cook for one minute, and add the reserved tail, the red wine, parsley, bay leaf, thyme, ham, pepper, and a little salt. Bring to a boil, cover, and cook in oven for two hours.
7. Add lamprey and its marinade to the mixture from step 6, stirring constantly as you bring it to the boil on top of stove. Reduce heat and simmer for five minutes. Remove lamprey pieces and set aside. Discard the tail.
8. Cover the saucepan and return to oven for seven hours.
9. Heat the remaining oil in a saucepan with the butter and cook the white parts of the leeks until golden. Add lamprey slices and Armagnac. Flame. Strain the sauce over the fish and stir carefully so that fish pieces don't break.
10. Cover saucepan and simmer over lowest possible heat for one hour, or less if the fish pieces seem about to break up. Serve with boiled potatoes and croutons.

Yield: 4 servings

12 YEARS OLD WORLDWIDE • BLENDED SCOTCH WHISKY
86 PROOF • GENERAL WINE & SPIRITS CO., NEW YORK, N.Y.



I'll be home for Chivas.

hexa·photo·cybernetic
The Possibilities are Endless.



Shutter-Priority: 1000 S 6

Six-mode exposure control. System versatility. Newer electronics for wider applications.



The Canon A-1 is one of the world's most advanced automatic SLR cameras. Combining the finest in optical and mechanical engineering with the most sophisticated electronics, it's technology applied to give you the ultimate in creative control. At the touch of a button.

Depending on your subject, you can choose from six independent exposure modes to achieve the results you want:

1 Shutter-Priority: You select the shutter speed, to freeze the action and prevent camera shake or create an intentional blur. The A-1 automatically selects the appropriate lens opening.

2 Aperture-Priority: Control the area in focus by selecting the lens opening for the effect you want. The A-1 matches with the right speed.

3 Programmed: When you need to shoot fast, just focus. The A-1 will select *both speed and aperture* for great results.

4 Stopped-Down: For extreme close-up or specialized photography, a bellows, a microscope or almost anything can be attached to the A-1. It's still automatic.

5 Flash: Totally automatic flash photography, of course, with a wide variety of Canon Speedlites to choose from.

6 Manual: Yes. For those times when you absolutely want to do it all yourself. To experiment. To explore the possibilities.





There are over forty fine Canon lenses ranging from Fish Eye to Super Telephoto, plus accessories to meet every need. If you can't photograph your subject with a Canon A-1, it probably can't be photographed.

From the sophistication of its LED viewfinder display, to a ruggedness that allows up to five-frame-per-second motor drive, the Canon A-1 represents an incredible technology. At a price that makes owning one a definite possibility.

Canon® A-1

Canon USA, Inc., One Canon Plaza, Lake Success, New York 11042 • 140 Industrial Drive, Elmhurst, Illinois 60126 • 6380 Peachtree Industrial Blvd., Norcross, Georgia 30071 • 123 Paularino Avenue East, Costa Mesa, California 92626 • Bldg. B-2, 1050 Ala Moana Blvd., Honolulu, Hawaii 96814 • Canon Canada, Inc., Ontario

© 1981 Canon U.S.A., Inc.

AMNH LIBRARY
100209762